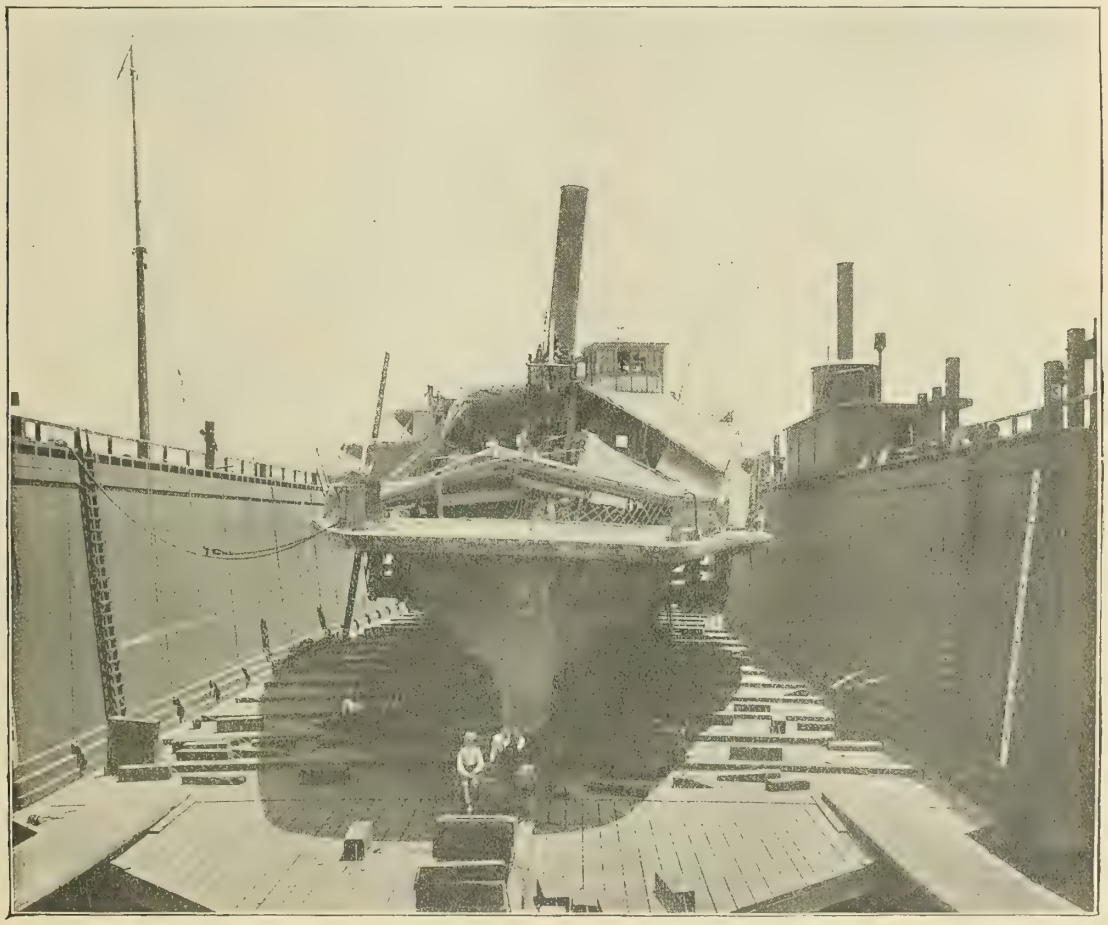
MARINE ENGINEERING.

Vol. 6. NEW YORK, AUGUST, 1901. No. 8.

THE NORTHFIELD ACCIDENT.

The accompanying illustrations show the wooden ferryboat *Northfield* on dry dock after colliding with the steel ferryboat *Mauch Chunk*. The *Northfield* was built at Brooklyn in 1863, and has many times undergone repairs and re-timbering to a greater or less extent. It will be remembered that on June 14, while leaving New York with nearly 1,000 passengers, she was run into by the *Mauch Chunk* and soon after sank. Many tugs and small boats went to her assistance and saved all but six of the passengers.

The bow of the steel boat passed under the *Northfield's* guard, scarcely scratching it, and plowed with full force into the side planking, shearing off stanchions and knees and opening up the hull for a space of 25 ft. The steel prow finished the wreck by cutting into the lower planking down as far as the bilge. A clear idea of the resulting damage can be formed by referring to the cut on page 312.



FERRYBOAT NORTHFIELD IN DRY DOCK AFTER THE COLLISION.

The *Northfield* is a very old boat and should have been condemned long ago, but no wooden vessel could have withstood such a direct blow and remain afloat. The upper works were also weak, as is shown in the il-

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lustration on the front page, of the end of the boat not in collision. The collapse of the decks was due chiefly to the action of the tides while the boat lay on the bottom.

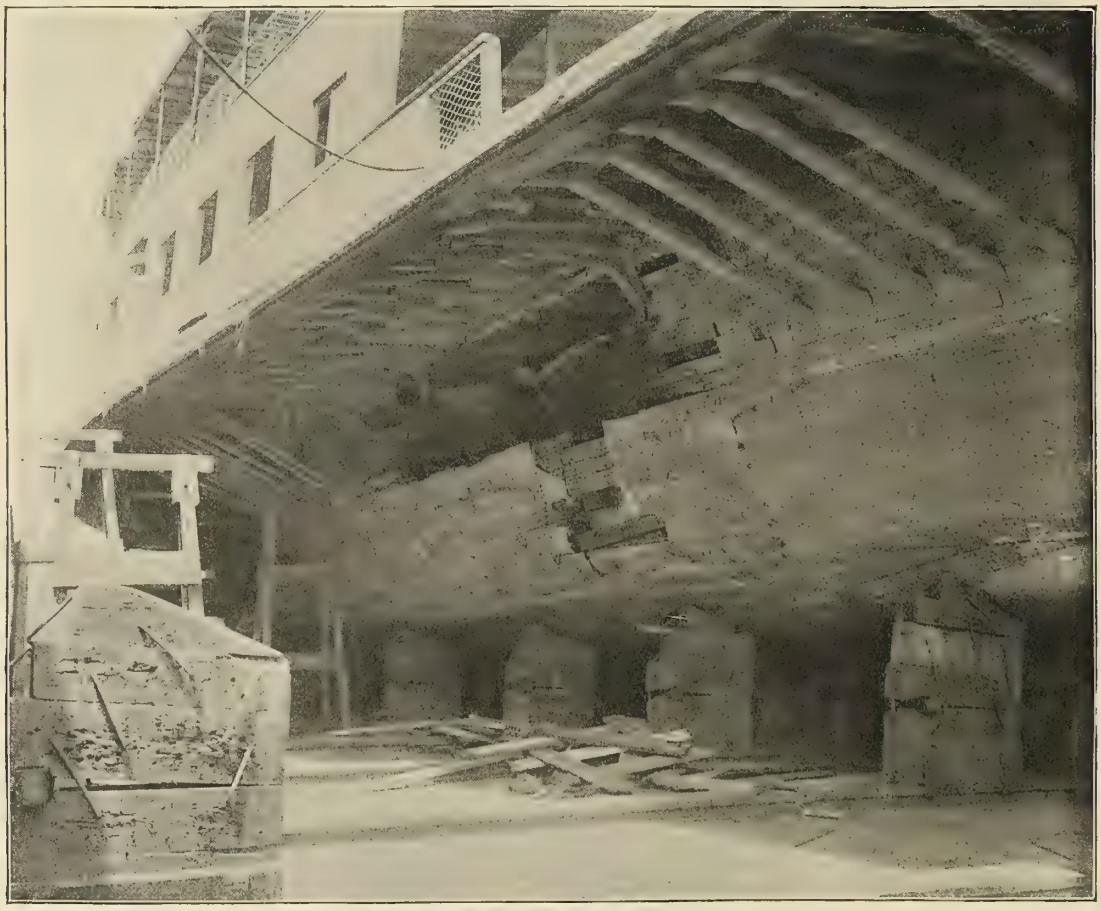
Ferryboats and other harbor vessels do not come under the rules for construction and inspection of any of the classification societies, and their condition for service depends entirely upon the disposition of the owners and the United States Steamboat Inspection Service. The subject of supplying an adequate number of life preservers and life boats is left entirely at the discretion of the supervising inspectors, who meet annually and pass rules and regulations to govern the service, which are approved by the Secretary of the Treasury. The third section of Rule VII Revised Statutes reads:

"All ferryboats carrying passengers shall be equipped as passenger steamers to such an extent as, in the opinion of the inspectors, shall, in each case, be deemed just and proper, *in accordance with the average number of passengers carried per trip.*"

The "average number of passengers carried" may be anywhere between one-quarter and one-tenth the maximum number carried during the rush hours at morning and night. An investigation made by the Police Commissioner of New York City as to the number of life-saving appliances carried on ferryboats and other harbor passenger boats, revealed the fact that there is about one life preserver to every ten persons and that even these are kept in such inaccessible places that it would be almost impossible to get them in time of peril.

The *Northfield* was docked for inspection by the underwriters. She was so severely damaged and has so much old timber in her, that it is doubtful, in view of public sentiment, if she will be repaired.

Electric Dry Dock.—A large floating dry dock has been built by the Morse Iron Works for use at South Brooklyn, N. Y. It consists of five sections or pontoons each 80 ft. long, and two extension ends each 36 ft. long. Other sections will be added to make the total length 800 ft. The pontoons are 120 ft. in width, and each has a lifting capacity of 3,000 tons. Electric motors are used to run the centrifugal pumps.



DAMAGE RECEIVED BY THE NORTHFIELD IN THE COLLISION.

Classification of Naval Ships.—A new classification of war ships has been ordered by the President which groups the vessels as follows: First rate, men-of-war only, of 8,000 tons displacement and upward; second rate, men-of-war of more than 4,000 tons and less than 8,000 tons, together with converted auxiliary vessels of 6,000 tons and over, except special ships, colliers, repair ships, tank steamers and the like; third rate, men-of-war from 1,000 to 4,000 tons and converted and auxiliary vessels of from 1,000 to 6,000 tons, and colliers, refrigerating ships, supply ships, distilling ships, tank steamers, repair ships, hospital ships and other vessels used for special purposes, of 4,000 tons and over; fourth rate, all other rated vessels. Torpedo boat destroyers, torpedo boats, tugs, sailing vessels and receiving ships are not to be rated.

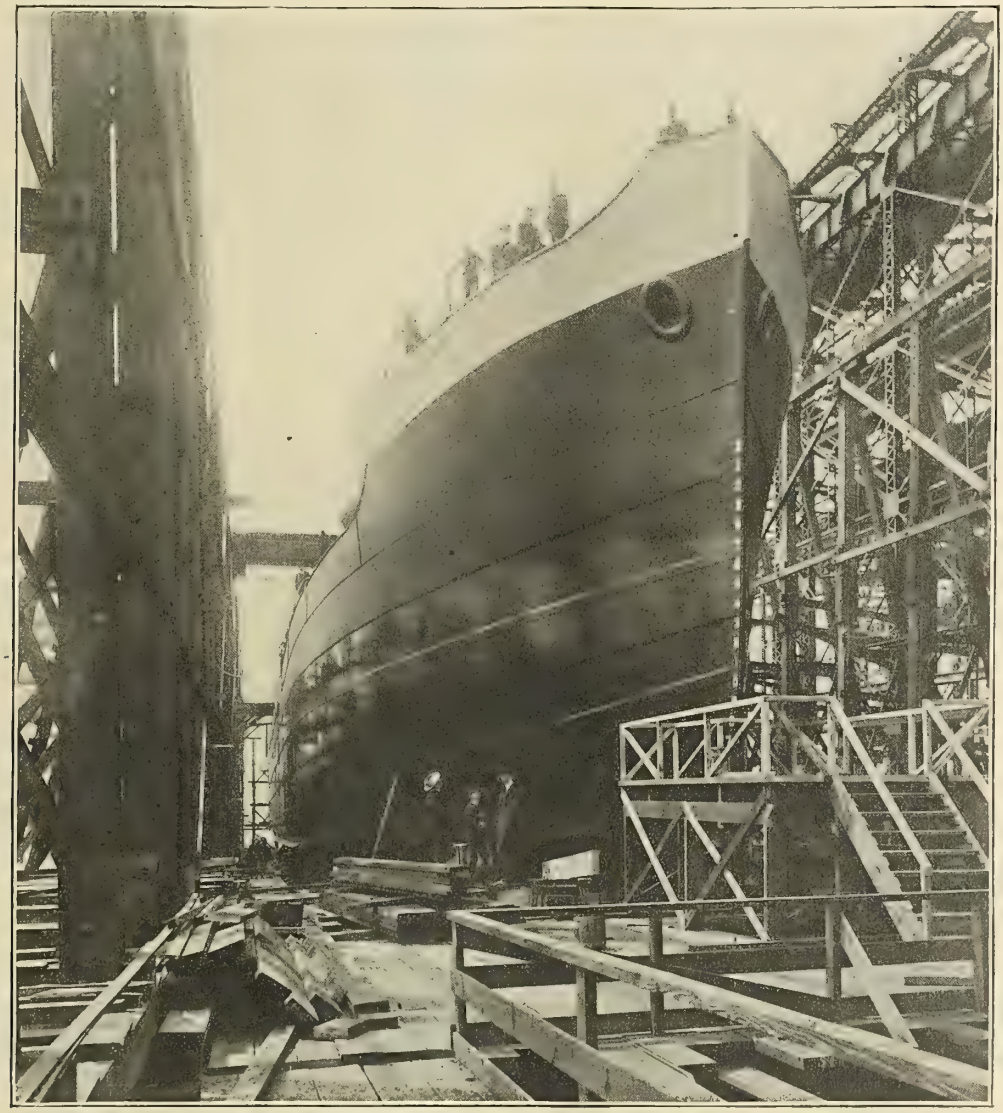
THE STEAMSHIP M. S. DOLLAR.

The *M. S. Dollar*, the first ship contracted for by the New York Shipbuilding Company, Camden, N. J., was successfully launched last month. She is a single screw steamer having a length over all of 309 ft. 7 in.; length between perpendiculars, 300 ft.; beam molded, 40 ft., and a molded depth of 26 ft. The load draft is 22 ft. and the corresponding dead weight capacity, including cargo, bunker coal, stores and water, is about 4,000 tons. The ship is of the three deck type and is built to receive the highest class of Lloyd's Registry.

There is a complete steel upper deck and a tier of main deck beams with no deck laid, except for a short distance forward of the machinery space to form a reserve bunker. There are no lower deck beams, web frames and deep hold stringers being fitted to provide the necessary strength.

A complete cellular double bottom is fitted for water ballast, and the fore and after peaks are arranged so that they may be used as trimming tanks, the total water ballast capacity being about 870 tons. The hold is divided into water tight compartments by five transverse bulkheads extending to the upper deck.

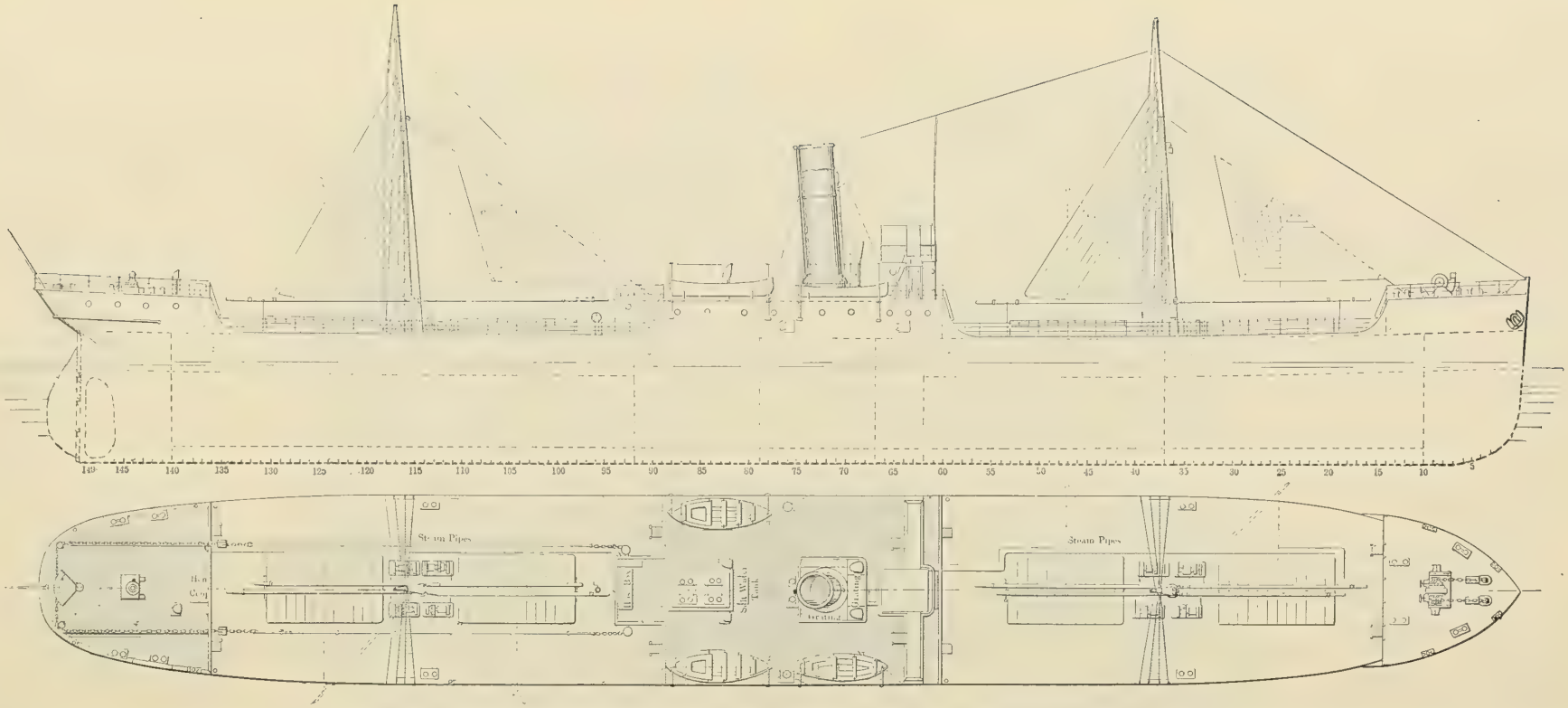
Above the upper deck are a poop, bridge house and forecastle. The poop is arranged to accommodate the crew and firemen, and in the forecastle are the carpenter's and boatswain's stores and lamp room. The brige house contains commodious quarters for the captain, deck officers and engineers, and on the forward end of the bridge deck is a large wheel house and chart room. Two steel pole masts are provided, each fitted to carry four cargo booms.



STEAMER M. S. DOLLAR READY FOR LAUNCHING.

The main engine is of the inverted cylinder, triple expansion, surface condensing type, having cylinders 22 in., 36 in. and 59 in. diameter, with a stroke of 42 in., the I. H. P. being about 1,500 at 80 revolutions, which is expected to maintain a speed of 10 knots at sea.

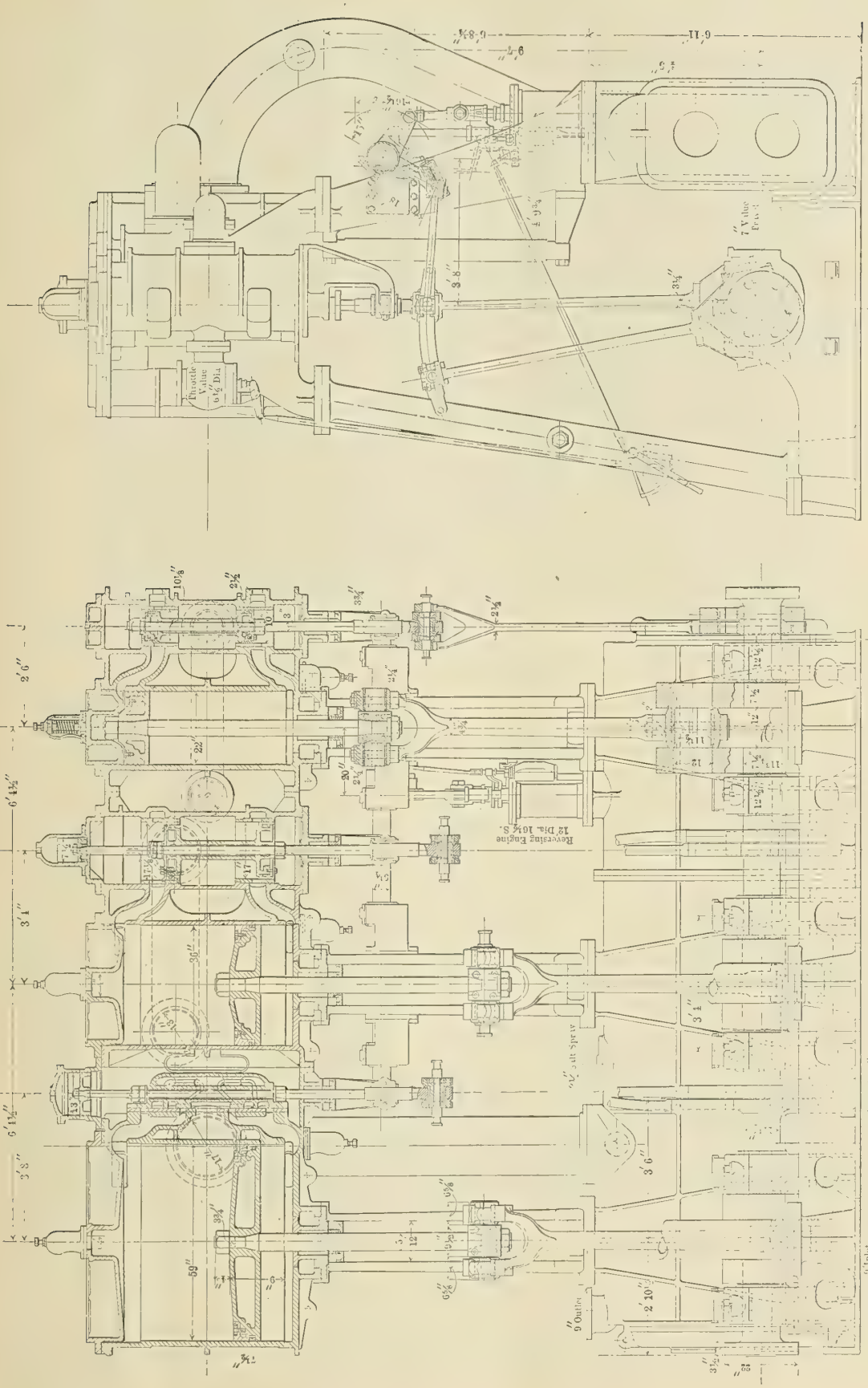
The bed plate of the main engine is in one piece of box section cast iron and is provided with six main



SAIL AND DECK PLANS OF STEAMER M. S. DOLLAR, BUILT BY THE NEW YORK SHIPBUILDING COMPANY.

bearings each 12 1-2 in. long. Three round hollow cast iron columns support the cylinders in front and three box section housings reach from the main condenser to the cylinder feet at the back. The cross head guides are of the box type, supported by the back housings, the slippers surrounding them. The main condenser extends the entire length of the main engine and is bolted to the back of the bed plate and contains 2,600 sq. ft. of cooling surface. The H. P. and M. P. cylinders each have one piston valve and the L. P. cylinder is provided with one double ported slide valve, the valve gear being of the Stephenson link type. The piston rods are of forged steel 5 in. diameter, fitted into flat cast iron pistons. The connecting rods are 96 in. between centers and provided with composition boxes at top and bottom. The crankshaft is built up in three interchangeable sections, 11 1-4 in. diameter, the crankpins being 11 1-2 in. diameter and 12 in. long. The thrust bearing is bolted to the main engine bed plate and fitted with six horseshoes of cast iron. The shafting is of steel, the tail shaft being incased in a composition sleeve in the way of the stern tube. The propeller is of the built up type all of cast iron, 13 ft. in diameter and 16 ft. pitch. The main air pump, 24 1-2 in. by 18 in., and the bilge pump are secured to the main condenser and driven from the M. P. cross head by steel levers. The reversing engine is of the direct acting type, 12 in. by 16 1-2 in., mounted on the main condenser and is fitted with floating levers. The turning engine, 6 in. by 6 in. single, is secured to the after end of the main engine bed plate. The independent auxiliary machinery in the engine room includes a main and an auxiliary feed pump, each 8 in. by 5 in. by 12 in. duplex; a water service and sanitary pump 7 in. by 4 1-2 in. by 10 in. duplex, and a ballast pump 12 in. by 14 in. by 12 in. duplex. The main circulating pump is driven direct by an independent engine 9 in. by 9 in. single, the impeller being 30 in. diameter and having 10 in. suction and discharge. An evaporator of 10 tons capacity and a feed water heater are also provided.

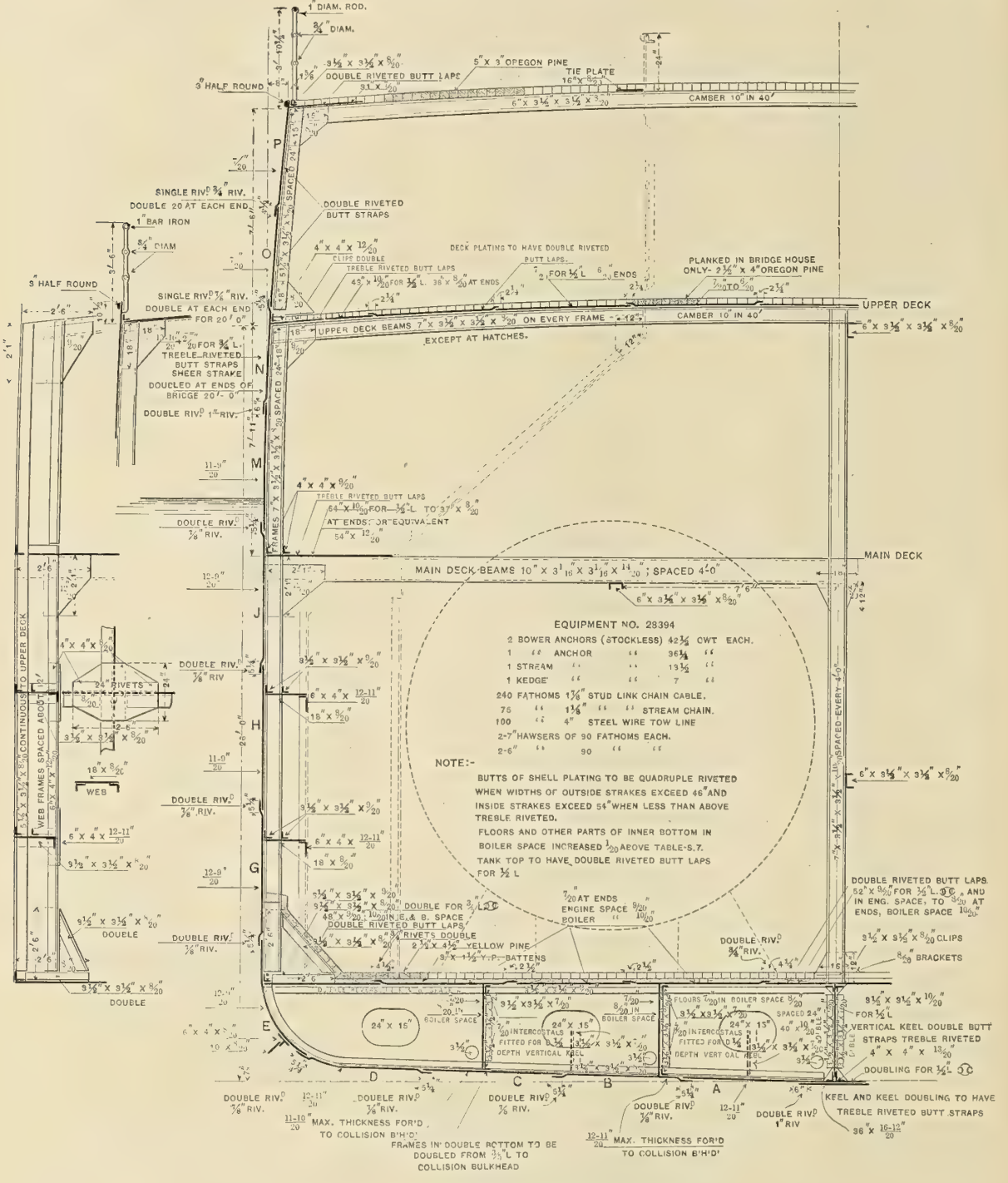
The main boilers are two in number, 14 ft. diameter and 12 ft. 2 in. between heads, each having three fur-



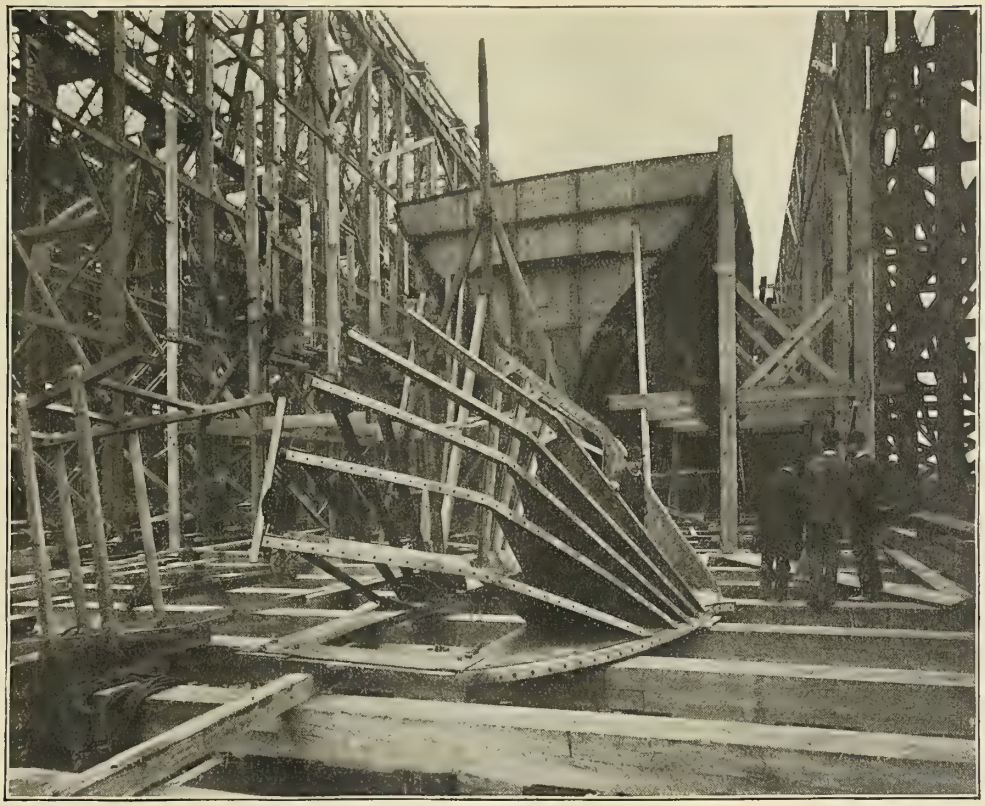
ENGINE OF THE STEAMER M. S. DOLLAR, BUILT BY THE NEW YORK SHIPBUILDING COMPANY.

naces 46 in. inside diameter and with one common combustion chamber. The tubes are 3 1-4 in. diameter and 9 ft. between tube sheets. The total heating surface is 4,320 sq. ft. and the grate surface 150 sq. ft., the grates being 6 ft. 3 in. long. An auxiliary boiler 10 ft. by 8 ft. is also provided in the boiler room. All boilers carry 175 lb. steam pressure, and are worked under natural draft. An ash ejector is fitted in the fireroom, provision also being made for hoisting ashes through one of the fireroom ventilators.

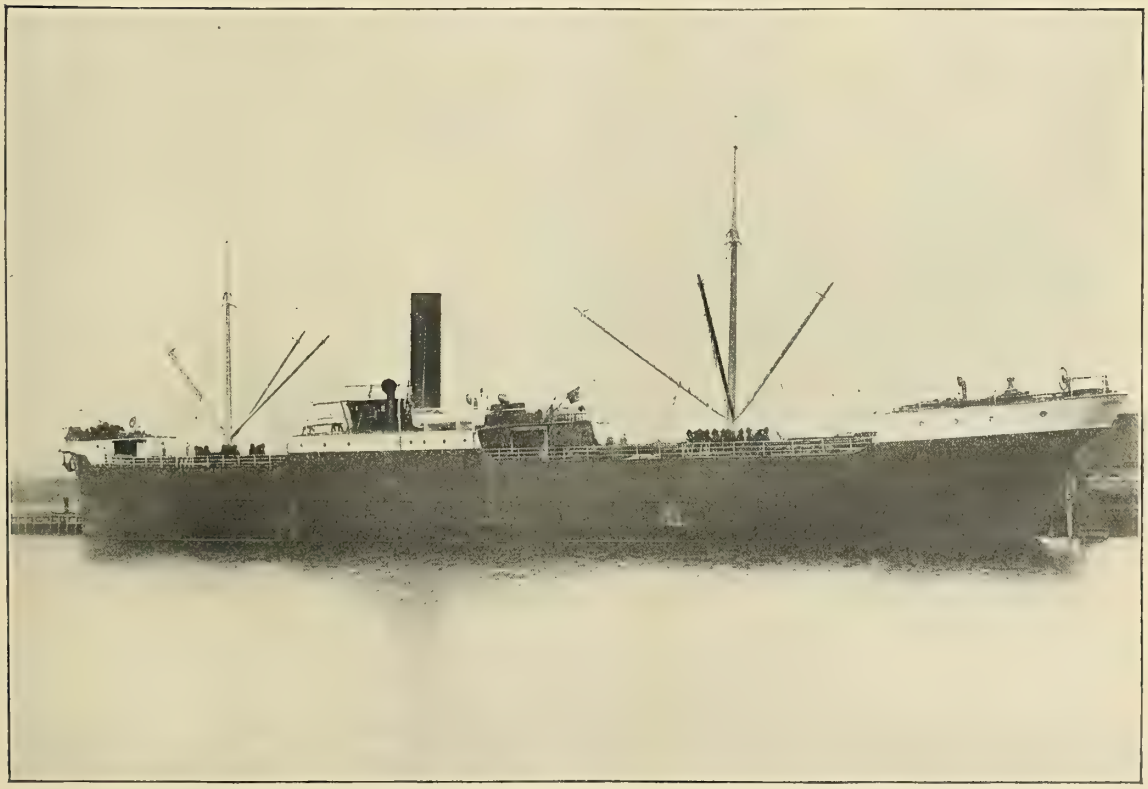
Fresh water is carried in the double bottom in the machinery spaces and a tank of 3,000 gallons capacity is provided in the engine room for drinking water. A large engineer's workshop and storeroom is also fitted with tools, lockers, oil and waste tanks, work bench, vises, etc., complete.


1" DIAM. ROD.
3/4" DIAM.
3" HALF ROUND
5" X 3" OREGON PINE TIE PLATE
DOUBLE RIVETED BUTT LAPS
CAMBER 10" IN 40'
DOUBLE RIVETED BUTT STRAPS
SINGLE RIV. 3/4" RIV. DOUBLE 20 AT EACH END
1" BAR IRON
3/4" DIAM
CLIPS DOUBLE TREBLE RIVETED BUTT LAPS
DECK PLATING TO HAVE DOUBLE RIVETED BUTT LAPS
PLANKED IN BRIDGE HOUSE ONLY- 2 1/2" X 4" OREGON PINE
UPPER DECK
UPPER DECK BEAMS 7" X 3 1/2" X 3/20 ON EVERY FRAME - 12" CAMBER 10" IN 40'
EXCEPT AT HATCHES.
SINGLE RIV. 7/8" RIV. DOUBLE AT EACH END FOR 20'0"
TREBLE RIVETED BUTT STRAPS SHEER STRAKE DOUBLED AT ENDS OF BRIDGE 20'-0"
DOUBLE RIV. 1" RIV.
4" X 4" X 8/20 TREBLE RIVETED BUTT LAPS
FRAMES 7" X 3 1/2" X 3 1/2" X 3/20 SPACED 24"
DOUBLE RIV. 7/8" RIV.
MAIN DECK
MAIN DECK BEAMS 10" X 3 1/16" X 3 1/16" X 14/20" ; SPACED 4'0"
EQUIPMENT NO. 28394
2 BOWER ANCHORS (STOCKLESS) 42 3/4 CWT EACH.
1 " ANCHOR " 36 1/4 "
1 STREAM " " 13 1/2 "
1 KEDGE " " 7 "
240 FATHOMS 1 7/8" STUD LINK CHAIN CABLE.
75 " 1 3/4" " " STREAM CHAIN.
100 " 4" STEEL WIRE TOW LINE
2-7" HAWSERS OF 90 FATHOMS EACH.
2-6" " 90 " "
NOTE:-
BUTTS OF SHELL PLATING TO BE QUADRUPLE RIVETED WHEN WIDTHS OF OUTSIDE STRAKES EXCEED 46" AND INSIDE STRAKES EXCEED 54" WHEN LESS THAN ABOVE TREBLE RIVETED.
FLOORS AND OTHER PARTS OF INNER BOTTOM IN BOILER SPACE INCREASED 1/20 ABOVE TABLE-S.T.
TANK TOP TO HAVE DOUBLE RIVETED BUTT LAPS FOR 1/2 L
DOUBLE RIVETED BUTT LAPS
DOUBLE RIV. 3/4" RIV.
3 1/2" X 3 1/2" X 8/20 CLIPS
8/20 BRACKETS
WEB
DOUBLE
24" RIVETS
3 1/2" X 3 1/2" X 8/20 DOUBLE FOR 3/4" L.
48" X 3/20 IN E. & B. SPACE DOUBLE RIVETED BUTT LAPS
3 1/2" X 3 1/2" X 8/20 3/4" RIVETS DOUBLE
2 1/2" X 4 1/2" YELLOW PINE
3" X 1 1/2" Y.P. BATTENS
7/20 AT ENDS ENGINE SPACE 9/20 BOILER " 10/20
24" X 15"
20 IN BOILER SPACE
FLOORS 7/20 IN BOILER SPACE 8/20
3 1/2" X 3 1/2" X 7/20
8/20 IN BOILER SPACE
24" X 15"
20 INTERCOSTALS FITTED FOR DEPTH VERTICAL KEEL
3 1/2" X 3 1/2" X 7/20
3 1/2" X 9 1/2" X 10/20 FOR 1/2" L. VERTICAL KEEL DOUBLE BUTT STRAPS TREBLE RIVETED
4" X 4" X 13/20 DOUBLING FOR 1/2" L.
KEEL AND KEEL DOUBLING TO HAVE TREBLE RIVETED BUTT STRAPS
36" X 16-12/20
DOUBLE RIV. 7/8" RIV.
DOUBLE RIV. 1" RIV
MAX. THICKNESS FOR'D TO COLLISION B'H'D'
FRAMES IN DOUBLE BOTTOM TO BE DOUBLED FROM 3/5 L TO COLLISION BULKHEAD
MAX. THICKNESS FOR'D TO COLLISION B'H'D'
WEB FRAMES SPACED ABOUT 12'
CONTINUOUS TO UPPER DECK
SPACED EVERY 4'-0"

MIDSHIP SECTION OF THE STEAMER M. S. DOLLAR.



VIEW OF STERN AND TRANSOM OF STEAMER M. S. DOLLAR.



STEAMER M. S. DOLLAR, BUILT BY THE NEW YORK SHIPBUILDING COMPANY.

The deck machinery includes a steam windlass on the weather deck with 9 in. by 9 in. double engine below; a reversible steam capstan, 6 in. by 8 in. double, located on the poop deck and eight vertical winches, 8 in. by 8 in. double, of the reversible type, conveniently located at the hatches on the main deck and a steam steering engine, 6 in. by 6 in. double, fitted in the upper engine room hatch.

An interesting point in the construction of this ship is the joggled shell plating, this being the first instance in which it has been used on this side of the Atlantic. In this system of construction the frame liners under the outside strakes of plating are dispensed with, the edge laps of these strakes being joggled or raised over the inside strakes, the remainder of the plate lying directly against the frames. By this means a very considerable weight of material is saved in the construction of the ship. In order to compensate for the absence of the wide bulkhead liners ordinarily fitted the hold stringers are increased in strength at the bulkheads.

A large proportion of the hull material of this vessel was laid out from templates made in the mold loft, only the shell plates at the ends of the ship being "lifted" in the ordinary way. The results obtained from this method of work have proven entirely satisfactory.

A further matter of interest is that since her launch the ship has been berthed in a covered slip, and not a day's work has been lost through inclement weather. The vessel received her machinery while in this slip, the main engines being placed in one piece by the 100 ton crane which travels overhead above the slip.

The *M. S. Dollar* is built for the lumber trade on the Pacific coast. The keel was laid November 27, 1900, the ship was launched May 4, 1901, and she will leave her builders in July.

COMPOUND VS. TRIPLE EXPANSION ENGINES.

BY C. A. M'ALLISTER,
FIRST ASST. ENGINEER, R. C. S.

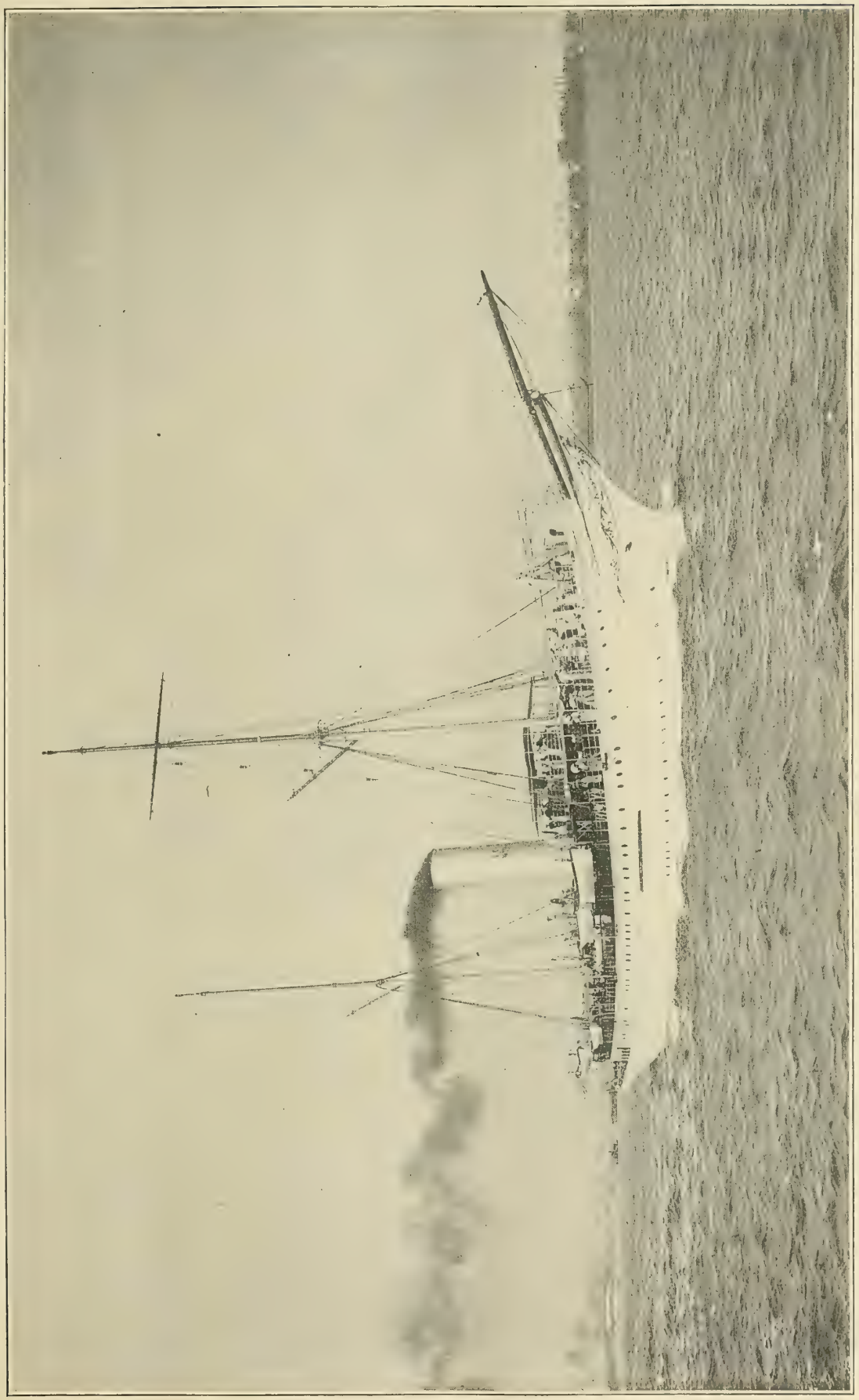
While at the present time there can be no controversy as to the economy of a triple expansion engine compared with the compound type, there are still many engineers who claim that for harbor use or for vessels making short runs the compound engine is practically as economical as the triple. Not only is such a claim made, but the best evidence of this belief is the fact that compound engines are now in course of construction at various yards, for tug boats and other harbor craft. Advocates of the compound type of engine for harbor duty all admit that the triple expansion engine is more economical for long trips, but steadfastly insist that for short and infrequent trips no economy is gained by using the more modern type of machinery. To such advocates a theoretical demonstration of the relative advantages would be unheeded, but the following facts might be more convincing.

There are in the United States revenue cutter service at the present time two boarding boats, the *Calumet* and the *Hudson*, of the ordinary tugboat type, whose duties are to place customs officials on board incoming steamers at the port of New York. The cutters in question perform practically the same amount of work, as they alternate in performing the boarding duties. While thus engaged they average four or five trips from the Battery to the Narrows per day, and in the intervals are tied up to the wharf under banked fires. The hulls are practically identical in design with the exception that the *Hudson* is 2 ft longer than the *Calumet*, and consequently has about six tons greater displacement. Each vessel is fitted with a water tube boiler of the same type and dimensions, having 74 sq. ft. of grate surface and 2,490 sq. ft. of heating surface. The *Calumet* has an ordinary two cylinder compound engine with a high pressure cylinder 18 1-2 inches in diameter and a low pressure cylinder of 32 in. diameter, the stroke being 26 in. The *Hudson* is provided with a three cylinder triple expansion engine with cylinders 13, 21 and 32 1-4 in. in diameter respectively, by 24 in. stroke. It will thus be readily seen that these two tugs offer a peculiarly reliable means of comparison, having almost similar hulls, identically the same make and size of boiler and performing the same kind and amount of work. While discussions of coal burned per square foot of grate, water evaporated per pound of coal, pounds of steam used per indicated horse power, etc., etc., are of great interest, the surest and best comparison is the coal bill. The Government is very exacting in its requirement as to the accounting for all supplies expended and the amount of coal consumed on any vessel can always be ascertained accurately. In order to minimize any inequality in the amount of work performed by each of these cutters the following statement of coal consumption is made to include each of the twelve months of the year ending June 30, 1901:

Month.	*Hudson* (Triple.) Tons.	*Calumet* (Compound.) Tons.
July	25.89	35 29
August	24.33	35.88
September	32 59	32.35
October	34.86	26.94
November	30.22	30 47
December	29.55	46 58
January	28 03	42.75
February	33.53	38.77
March	35 22	39 85
April	35 86	40 22
May	35.18	36.79
June	27 23	34 96
Total	372.43	440.85

From the above it will be seen that the *Hudson*, with a triple expansion engine, burned 68.42 tons less than the *Calumet*, or that the *Calumet*, with her compound engine, burned 18 per cent more coal than the *Hudson*. These are actual results obtained under all conditions, and need no further comment. It may also be interesting to note that the cost of the repairs to the steam machinery of these two vessels was for the year about the same.

The pictures of the U. S. S. *Mayflower* used in the July issue of MARINE ENGINEERING were reproductions of photographs taken by E. Muller, 714 Monroe street, Brooklyn, N. Y. Mr. Muller has had these photographs copyrighted, which by oversight was not mentioned. The pictures illustrating the battleship *Ohio* were also taken by Mr. Muller, who has the original negatives.



THE U. S. AUXILIARY CRUISER MAYFLOWER.
(*Copyright, 1901, by E. Muller, Brooklyn, N. Y.*)

DETAILS OF CONSTRUCTION OF THE FAMOUS AMERICAN CLIPPER SHIP GREAT REPUBLIC.

In these days of the six masted schooner and other large sailing vessels of the square rigged type, it is often supposed that the ships now launched are vastly larger than their predecessors. In fact, the very spirit of advancement and improvement of the age often leads to a mistaken idea of the capabilities of those who have gone before. The great American wooden clipper ships of the past century have, however, not been surpassed in point of size nor, we believe, in performance afloat.

A famous example of the old clipper is the *Great Republic*, of Boston, which was built, owned and managed by Donald McKay. We have recently been favored by one of our subscribers, F. V. Clark, with a most interesting description of this vessel which was privately circulated at the time of her construction in the middle of the last century. This, according to the title page, was "written by a sailor," and it is an interesting and quaintly worded description, which we are glad to have the opportunity of republishing, in part, as a tribute to the men who, in ante bellum days, sent the American flag to the ends of the earth flying from the finest ships of the age. We also reproduce the plans of this noble vessel, which, along with the technical details of construction, are of present professional interest.

With the discovery of gold in California came a great demand for ships to make the passage from Atlantic coast ports around the Horn to the Pacific coast. Many large sailing vessels were built and put in the trade, the competition for the speed record being fully as keen as that which prevailed in the later years of the century in the steam transatlantic trade. One notable vessel of the period was the *Flying Cloud*, 1,700 tons, built by Donald McKay, which made the passage from New York to San Francisco in 89 days, the largest days' run being 374 geographical miles. Later Mr. McKay built a still larger vessel, the *Sovereign of the Seas*, 2,400 tons, which made a record of 430 miles in 24 hours, and 3,144 miles in 10 consecutive days. This vessel, though looked upon at the time as too large and costly for any trade, was very successful, and in less than a year her gross earnings amounted to $200,000. Her owner decided to build yet another and larger vessel, and the clipper *Great Republic* was the result. She was "a ship of 4,000 tons register, and full 6,000 tons stowage capacity." In her construction there was used 1,500,000 ft. of hard pine, 2,056 tons of white oak, 336 tons of iron and 56 tons of copper. The total days' work on her hull footed up 50,000. In a suit of her sails there were 15,653 yards of canvas, and she carried a crew of 100 men and 30 boys. Continuing her description, we quote from our authority:

"She is 325 ft. long, 53 ft. wide, and her whole depth is 39 ft. The keel for 60 ft. forward is gradually raised from a straight line, and curves upwards into an arch, where it blends with the stem, so that the gripe of her forefoot, instead of being angular, like that of other vessels, is the complete arc of a circle. This arch, both inside and outside, is formed of solid oak, and binds all the joints together, so that the greater the pressure the more firmly will the arch be knit together. Strength, however, is only one reason for adopting the arched form for her forefoot; another reason is to facilitate her working, and at the same time to make her entrance as clean as possible, to obviate resistance. She has vast surface of floor, with about 20 in. dead rise, and a very long and clean run, which, however, as it rises, is spread out to prevent her settling aft, no matter how swiftly she may fly through the water. Her lines are concave forward and aft, up to a few feet above the load displacement line, but become gradually convex as they ascend and form her outline on the plankshеer. The angular form of the bow, however, is preserved entire; and such a bow for sharpness, beauty and strength has never before been produced in this country. Yet it is plain, even to nakedness, having the national eagle represented as emerging from below the bowsprit as its only ornament. But even simple and appropriate as is this ornament, it adds nothing to the beauty of the bow.

"Her sides are arched, or swell somewhat like those of a ship of war, but not so much in proportion to her size; and her sheer is graduated her whole length, with just sufficient rise forward, to impart ease and grace to the bow. She has a waist of nine narrow strakes, defined between the mouldings of the upper wale and the plankshеer, and every line and moulding is graduated to correspond with her sheer. Her stern is semi-elliptical in form, and corresponds well with her after body. It is spanned by a large, gilded eagle, with the American shield in his talons, and extends 36 ft. between the tips of the wings. Her name and port of hail are also on the stern, and its ground, as well as the hull, is painted black. She is yellow metalled up to 25 ft. draught. Instead of bulwarks, the outline of her spar deck is protected by a rail, on turned oak stanchions.

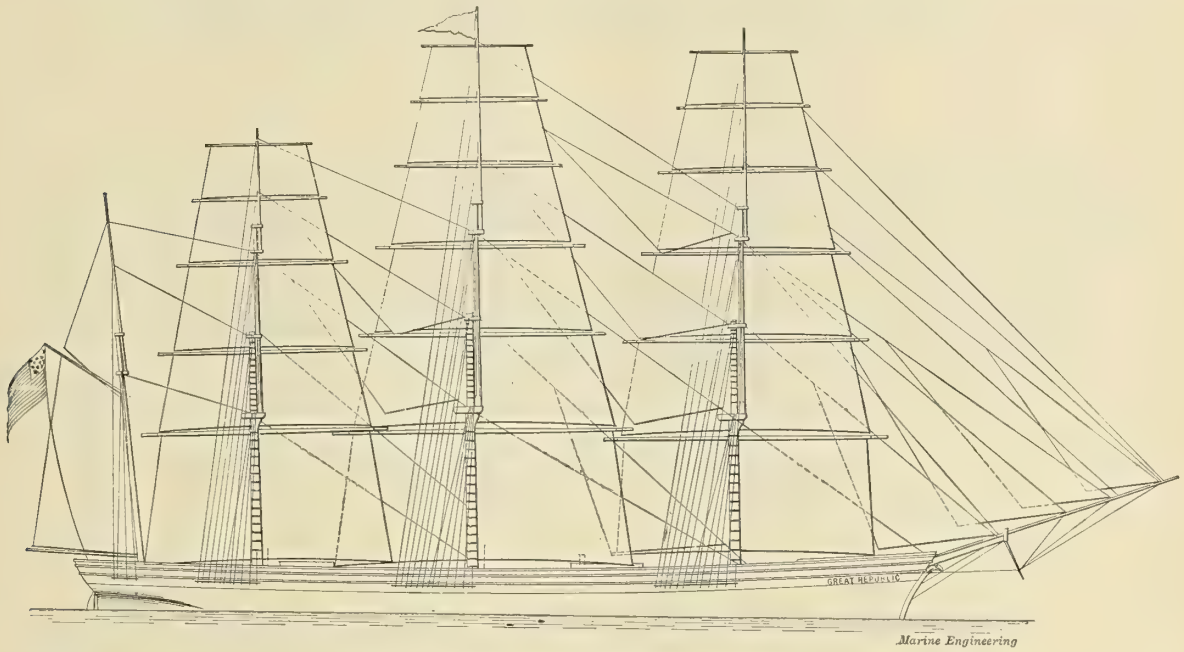
"She has four complete decks. The height between the upper and spar decks is 7 ft., and between each of the others 8 ft. Abaft the foremast is a house 23 ft. long by 16 ft. wide, the forward part of which is designed for a work room in wet weather, or as a shelter house for the watch on deck in stormy weather. The after part of it is a sick-bay or hospital, where those off duty will be properly taken care of, and every means used to restore them to health. Abaft the fore hatchway is another house, 25 ft. long, 16 ft. wide and 6 1-2 ft. high, which contains the galley, and abaft the galley is a blacksmith's shop and an engine room, where there is a steam engine of 15 horse power. This engine is designed to do all the heavy work of the ship, such as taking in and discharging cargo, setting up rigging, working the fire engine, hoisting topsails, pumping ship, etc., and connected with it is an apparatus for distilling fresh water from salt water. The advantages of a steam engine on board of such a ship must be great, and must prove a blessing to her crew, as well as a source of profit to her owner.

"Abaft the mainmast is another house, 40 ft. long by 12 ft. wide, which contains a mess room for the

officers, and has a staircase in its forward part, which leads to the quarters of the petty officers and boys, on the deck below. Farther aft there is still another house, 17 ft. long by 11 1-2 ft. wide, of the same height as the others. It protects a staircase which leads to the vestibule of both cabins below, and contains lockers, etc. **Aft, near the taffrail,** is the wheel house. Like a ship of war she has a double wheel, an iron tiller, and a gun tackle purchase, as her steering apparatus. She has four large boats on the spar deck, two of them 20 tons each, 30 ft. long, 10 1-2 ft. wide, and 5 ft. deep, fitted with sails and all the other appliances necessary to preserve life in the event of disaster to the ship. She also carries four quarter boats of 26 ft. length, and a captain's gig of 22 ft. Notwithstanding the space occupied on the spar deck by the houses and boats, such is her vast size, that

"Abaft the heel of the bowsprit are the riding bitts, and abaft the capstan, near the foremast, are other bitts, suitable for weather bitting, so that she has bitts enough to ride with four anchors down. The space abaft the foremast will be partly occupied with spare spars, hawsers, spare rigging, etc. Between the accommodations for her crew, and the after storerooms and cabins, there is space for 5 or 600 tons, which will be used as occasion requires.

"Abaft the after hatchway is a large sail room, with a boatswain's storeroom next to it, and abaft the latter is another sail room for light sails, such as studding sails and staysails. Farther aft are rooms for the boys, for she will carry thirty boys, and has spacious accommodations for them near the cabin of the petty officers. Leading from the sides of the petty officers' and boys' cabins, are a carpenter's room,



SAIL PLAN OF CLIPPER SHIP GREAT REPUBLIC.

the deck looks comparatively clear fore and aft, and is more roomy for working ship than that of a ship of the line. There are four working hatchways, the main one 11 by 14 ft. in the clear, which is large enough to take down an omnibus, if required. Her heavy spare spars are stowed on the deck below, and in the spar deck on each side is an oblong square opening, combinged the same as the hatchways, to admit of the spars being taken up or sent down. These openings, when not required, are hatched over, the same as the other hatchways. She will also carry spare topsail yards in her channels, like the heavy ships of war.

"The accommodations of her crew are on the upper between decks, and as she purchases her anchors with a capstan instead of a windlass, the space is not only ample, but light and airy as the cabin, and is most admirably designed for comfort and safety; and the entrances on the spar deck are protected by companions.

staterooms for the second officer and steward; and farther aft, two staterooms and the pantry. Next, aft, is the dining saloon, which is 30 ft. long by 14 ft. wide, and contains four large staterooms on each side. It is finely painted and grained, and elegantly furnished; and its staterooms are spacious, and well designed for the accommodation of passengers. Abaft the dining saloon is a vestibule, which communicates with the deck above and with both cabins below. It contains the captain's cabin on the starboard side, and the chief officer's opposite, both handy to the deck, and both clear of the cabins, so that their occupants may be called at all times, without interfering with the passengers.

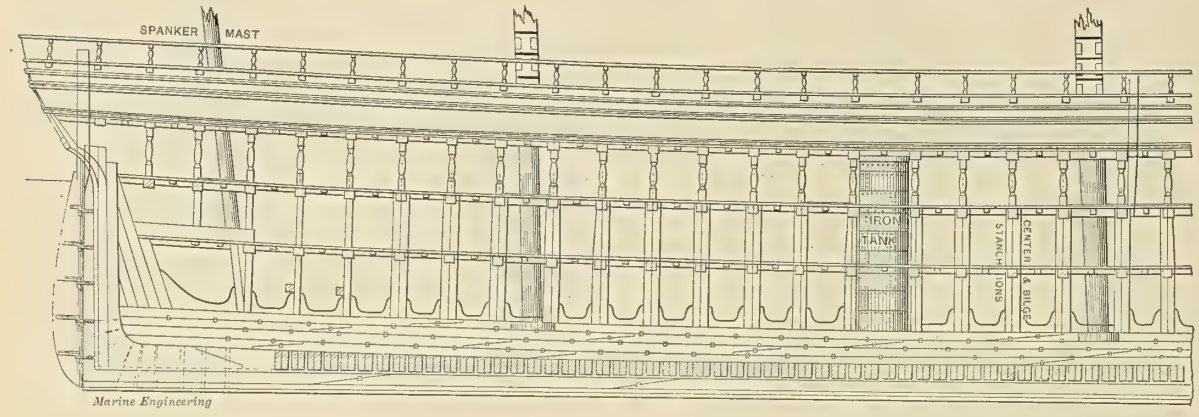
"The after cabin is 25 ft. long by 14 ft. wide, and contains three staterooms on each side, two recesses with sofas, and is beautifully wainscotted with mahogany, rose and satin wood, set off with pilasters, papier maché cornices, and gilded mouldings. The backgrounds of the recesses are ornamented with plate

glass mirrors, and mirrors also ornament the forward part of the cabin. The curve of the stern is fitted with a sofa, and over it, aft, are circular plate glass air ports, and over all an oblong square skylight. In every stateroom there are also deck and side lights, and skylights over all the other cabins, already described.

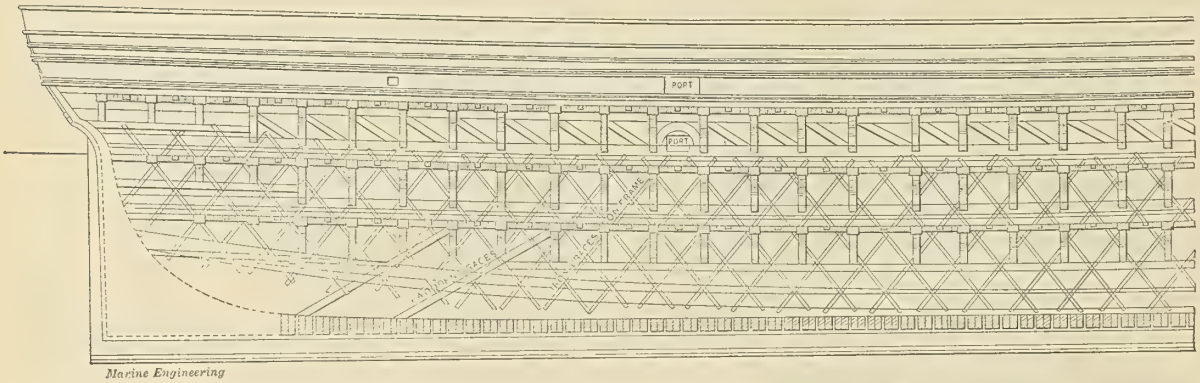
"On this deck, in each side, there are three large ports, with bitts near them, suitable for making the ship fast by when alongside of a wharf.

"Her chain lockers are in the lower hold forward, and before the main hatchway and abaft the mainmast are two iron water tanks, each of 8,000 gallons capacity. The space between the other decks and the hold is entirely clear for the stowage of cargo, and in the sides of the main deck are three cargo ports, nearly as large as those between the decks above. She has also double main hatchways below, so that goods hurriedly put in the decks below in rainy weather can be lowered into the hold without exposing them to wet.

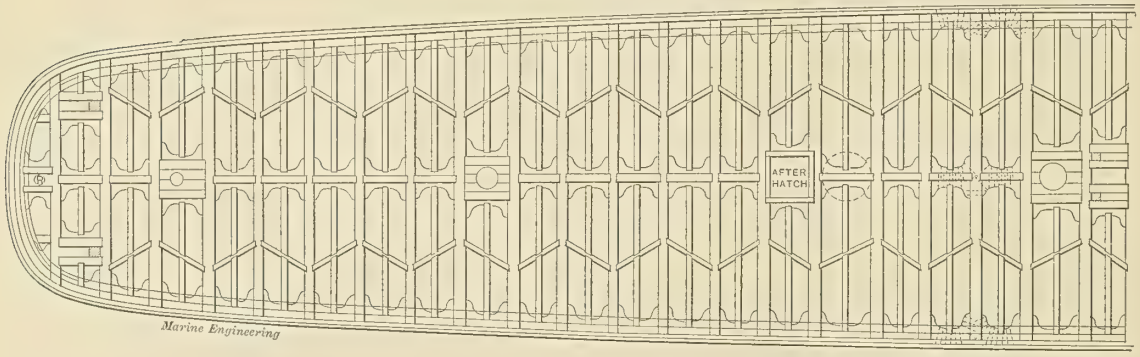
"These details will convey a general idea of the



LONGITUDINAL ELEVATION SHOWING



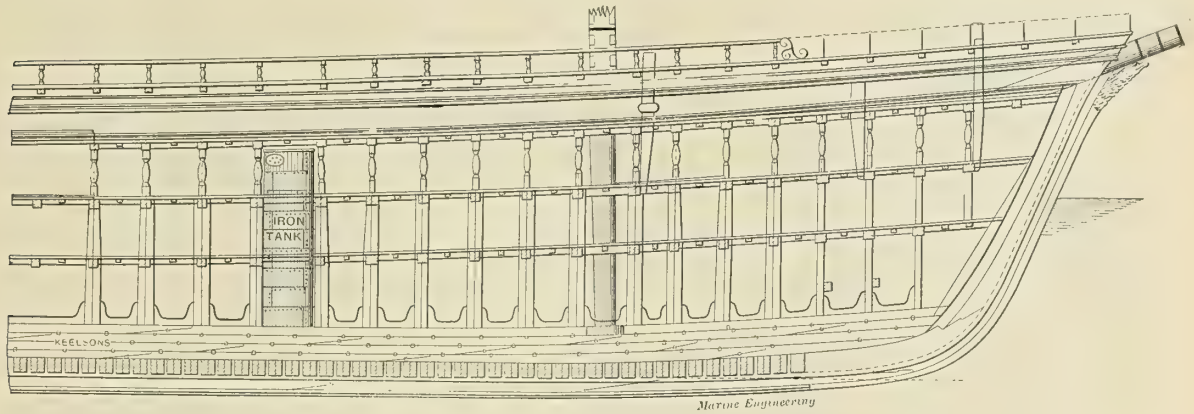
ELEVATION SHOWING DIAGONAL IRON BRACES



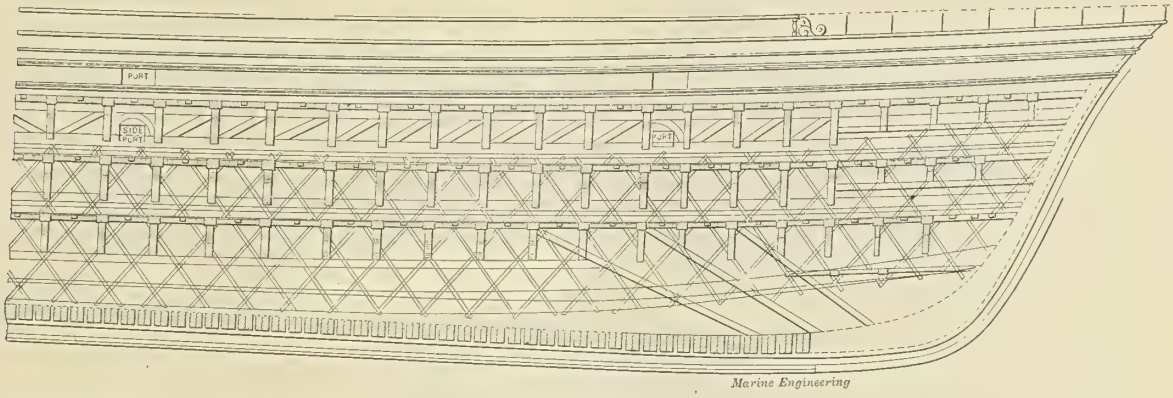
PLAN OF THIRD DECK UNDER SPAR DECK

outline of this splendid ship, and now the details of her materials and construction will be reviewed.

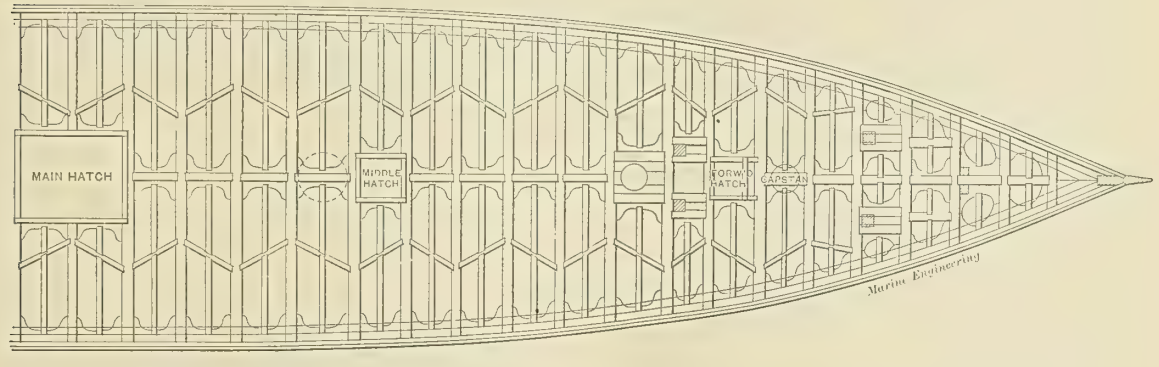
"The keel is of rock maple, in two tiers, which combined side 16 in. and mould 32 in., and the scarphs



KEEL, STANCHIONS, BEAMS, STEM, STERN, ETC.



OUTLINES OF DECKS, HANGING KNEES, ETC.



OF CLIPPER SHIP GREAT REPUBLIC.

are 12 ft. long, which, as well as the parts of the keel, are bolted with copper. The shoe, or false keel, is 4 1-2 in. thick. Her frame is of selected seasoned white oak. The floor timbers on the keel are sided from 12 to 15 in., and moulded 22 in., and the top timbers at the plankshear vary from 11 to 13 in. sided, by 8 in. moulded. The space of frames from centre to centre is 26 in. All the frames are doweled or coaged and bolted together, near every joint. The coags are of white oak, cylindrical in form, 3 1-4 in. dia. and 3 1-2 in. long, and join both parts of the frame together, after which an inch bolt was driven through the frame and the heart of the coag. The object of coaging is twofold: first, it binds the joints together beyond the possibility of working; and, second, it protects the iron bolts driven through them from being corroded by salt water. Any person who has inspected a vessel of seven or eight years old,

undergoing repairs, could hardly fail to observe that the frame boltings were corroded, and that the action of frequent calking had raisd the butts of the frames. To guard against these contingencies is the object of coaging this ship's frames. But she is closely coaged elsewhere, as will be seen hereafter.

"Her stem is sided the same as the keel, and is moulded 2 ft. at the foot, and 4 in. less at the head, and the cutwater is tapered almost to an edge, to correspond with the sharpness of the bow. The apron is 4 1-4 ft. through, and fills the angle of the bow, and inside of that is a massive stemson, which forms an arch covering all the joints of the stem and keel, as they meet at the forefoot, and also receives the lower ends of the cants. Every through bolt in the stem, apron, stemson and cutwater is of 1 1-4 in. copper, up to 26 ft. draught, and the bolts are nearly within 6 in. of one another.

"The stern post is in three upright pieces, coaged and bolted together, sided the same as the keel, and moulded between 5 and 6 ft., with five angular supports inside. The stern knee is sided 16 in., is moulded 3 ft. in the throat, and extends 8 ft. along the sternpost and 20 ft. along the keel, and is scarphed to the lower midship keelson, and bolted with copper. The sternpost is bolted in the same style as the stem.

"Her frame is diagonally cross braced with iron on the inside, fore and aft, the braces 4 in. wide, 1 in. thick, and 36 ft. long, and extend from the floor heads to the top timbers. There are 90 of these on each side. The first brace is let into the frames, and the second, or cross brace, is let into the ceiling, and these are bolted with inch iron into every timber, and are riveted together at every intersection.

"Her keelsons, ceiling and deck frames are of hard pine. She has four tiers of midship keelsons, each 15 in. square, and three tiers of sister keelsons, the two first 15 in. square, and the upper one 12 by 14 in. These are all coaged and bolted together vertically, and are lock scarphed and square keyed. There are two 1 3-8-in. copper bolts through every floor timber and the keel, the first driven through the timber and the keel, and the second through the first and second tiers of keelsons also, and all riveted on the base of the keel. The navel timbers are bolted through all the keelsons with iron driven into the keel, within a few inches of its base. These bolts were so long and stout, that it was found necessary to drive them with a pile driving machine. The sister keelsons are bolted diagonally through the navel timbers into the keel, and horizontally through the midship keelsons. The whole depth of her back bone, from the top of the keelsons, including the moulding of the floor timbers, is 9 ft. 10 in., and its spread on the inside is 45 in.

"There are nine strakes of 10 by 12 in. on the floor, all scarphed, square fastened through the frames, and bolted edgeways together every 5 ft. Over the floor heads are four bilge keelsons, each 15 in. square and in two depths. These are also coaged together, scarphed, keyed, square fastened with 1 1-4 in. refined iron and bolted edgeways, also. The ceiling above is in two depths, the first 6 in., and the second 15 in., the latter covering all the scarphs of that below, and is itself scarphed, and both are square bolted. In a few words, she is square fastened and edge bolted throughout, on the inside, and scarphed and keyed in all her ceiling. The whole bilge is double ceiled in this style, up to a lap strake of 6 by 15 in., upon which the lower ends of the hanging knees rest, and the lower deck clamps are also in two depths, of 6 and 10 in. thickness, fastened and finished in the same style as the work below.

"The waterways of the lower and main decks are 16 in. square, the strake inside of them 10 by 12 in., and the thick work over them 12 by 18 in.; and the waterways and deck strakes are coaged in every beam, and bolted through the coaging, and are also bolted vertically and horizontally. The ceiling above is 8 in. thick, scarphed, keyed and square bolted, and the clamp under the upper deck beams is 12 by 15 in."

(*To be continued.*)

The French Battleship Hoche.

The illustration on the opposite page shows the French battleship *Hoche*. This ship is one of the older type of heavy battleship construction, having been launched at Lorient in 1886 and completed in 1891. She is one of a class of four, the others being the *Magenta, Neptune* and *Marceau*. The principal features of the *Hoche* will be of interest as marking a type which is being displaced in many details by the features of present day construction and armament.

The principal dimensions are as follows:

Length	333 ft.
Beam	65 ft 7 in
Draft	27 ft. 3 in.
Displacement	11,000 tons

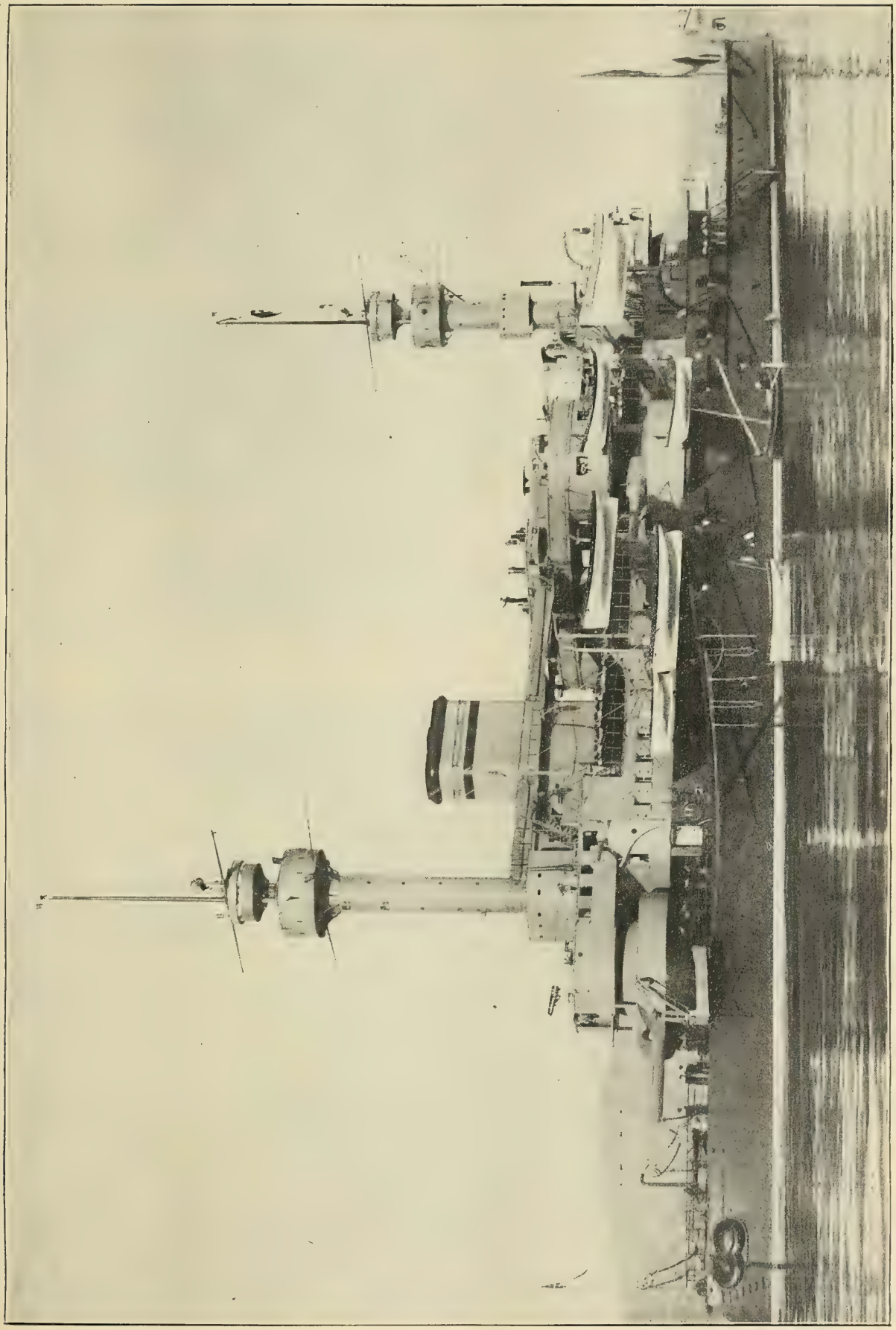
The engines are twin screw and develop about 11,300 I. H. P., giving the ship a speed of 16 knots. The normal coal supply is 800 tons.

The *Hoche* is protected by a belt of 18 in. steel armor with 16 in. armor on the gun positions and an armored deck of 3 in. thickness. She is armed with two 13.4 in. heavy guns, two 10.8 in. heavy guns, eight 5.5 in. quick firing guns and eight 12 mm. machine guns. Five torpedo tubes are also fitted.

The heavy turrets are located amidships forward and aft with low bow and stern like the English *Admiral* type while between these the superstructure is built up so as to give to the ship at a distance somewhat the appearance of a floating castle.

In 1895 the *Hoche* was partially rebuilt, several changes being made in the details of the superstructure with a view of rendering the battery more effective. Since that time she has done her fair share of duty with the French fleet and is still to be reckoned on as one of the features of the present French naval equipment.

Sailing Hotels.—Beginning with July 18, a fleet of three ships fitted as floating hotels will make daily excursions from the Battery, New York, leaving at 6 P. M. for the ocean, returning at 6 o'clock the following morning. The vessels have been equipped by John Arbuckle, and are intended for public use. Meals will be served on board and good staterooms are provided.



FRENCH BATTLESHIP HOCHE.

SHOOTERS ISLAND SHIPYARD.

It is with satisfaction that persons interested in the shipping of New York City note the rapid progress and development of the Townsend & Downey Shipbuilding and Repair Co. at Shooters Island, N. Y. After leading the world in shipbuilding in the days when steam was in its infancy and steel and iron construction was unknown, New York during the last half century and until within recent years, has given place to the Delaware and Eastern ports in the great industry of shipbuilding. She is now, however, regaining her position and to-day there are a number of new yards in successful operation about the harbor, securing a good share of the repair and new work of this, the greatest port of the country. While conditions are such that shipbuilding can never return to Manhattan Island, there are many suitable locations along the miles of water front of the Bay and tributaries for establishing great shipyards. It is beyond the scope of this article to enter into the economic conditions which favor or oppose the building of such yards near New York, but suffice it to say that during the year ending June 30, 1900, 4,018 vessels cleared from this port out of a total of 15,408 vessels cleared in the same period from all Atlantic and Gulf ports.

Among the largest yards in this locality is that located at Shooters Island, at the mouth of Newark Bay, one mile from the Kill von Kull. The works cover the entire island and are equipped for handling both new and repair work. The island is reached by the company's ferry running from Staten Island. The visitor is landed at the main office on the south side of the island. On the first floor are the business offices while the second story accommodates the draughting departments. To the left is a section of the yard given up to light class work, such as small sailing boats and launches, and beyond are the ways for larger steel vessels. At the western end of the island are the machine shop, mold loft and power house. The machine shop is equipped with large modern tools, including a Bement-Miles 108 in. swing lathe, a Pond shafting lathe, 45 ft. long, a Gray & Co. planer, 8 ft. by 20 ft. travel, a Niles 9 ft. boring mill, and over all runs a 25 ton traveling electric crane.

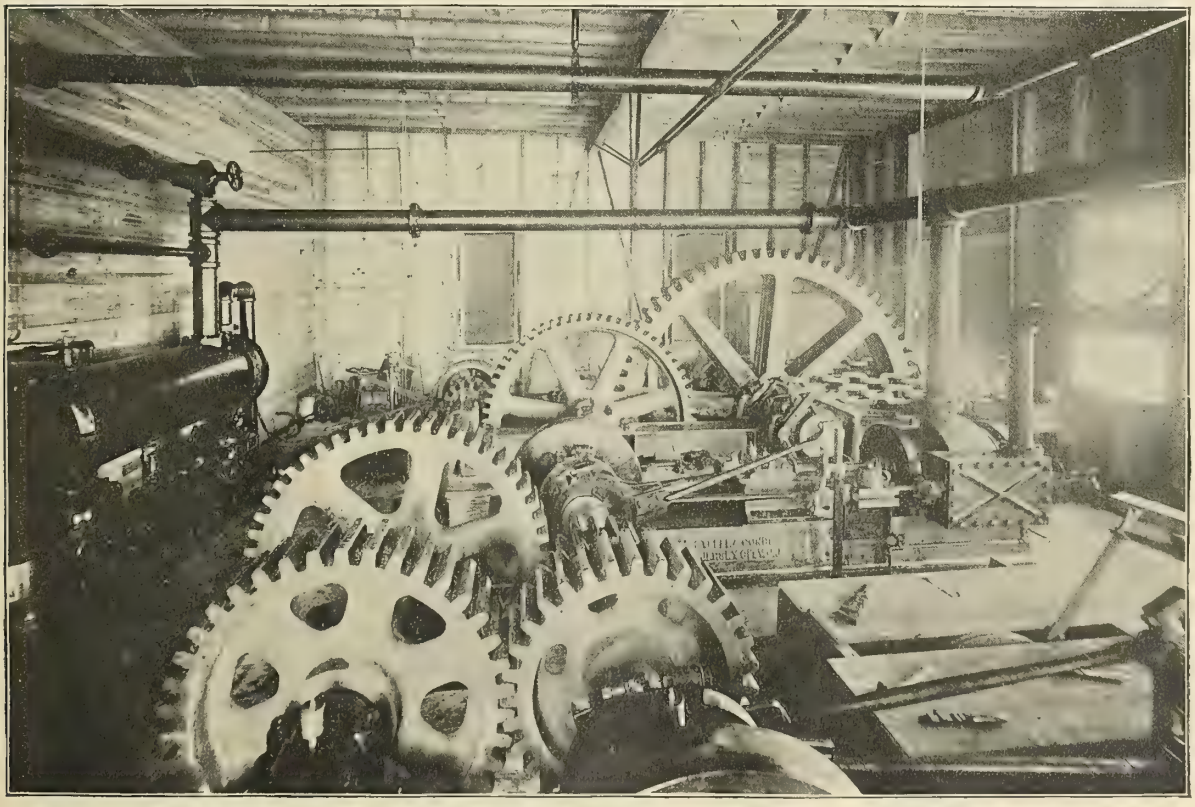
VIEW OF SHOOTERS ISLAND FROM THE SOUTHWEST.

VIEW OF SHOOTERS ISLAND FROM THE SOUTH.

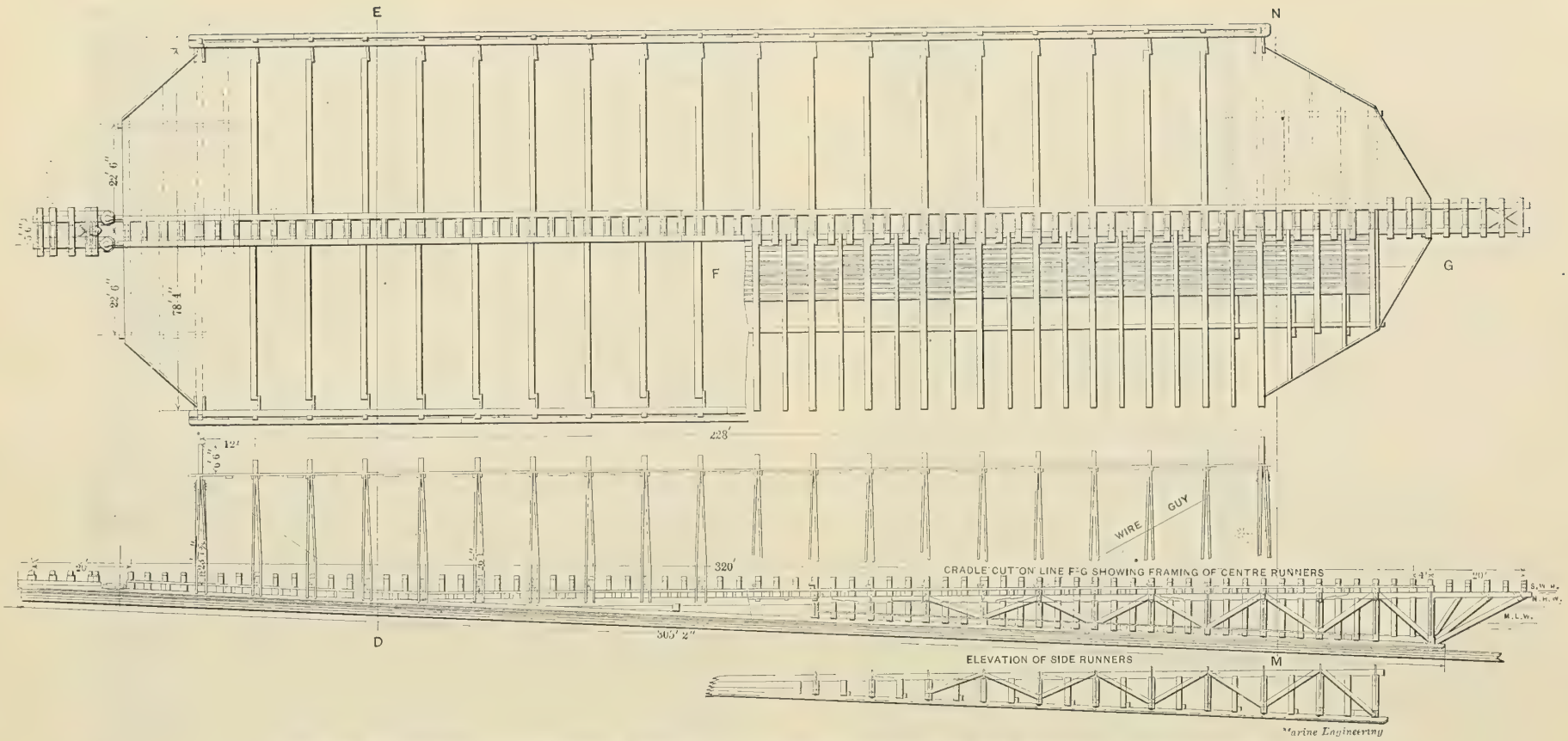
In the power house are two engines, one driving the line shafting for the machine shop and the other running two electric generators which supply current for lighting, for running the saw mill, individual motors in the plate shed, blacksmith shop blower and machine shop crane. An Ingersoll & Sargent compressor furnishes air for running the hand tools, riveters, reamers, drills, etc., about the yard and at the ways.

North of the machine shop and on the water front a new blacksmith shop is being built. To the east lies the plate shed well fitted with large punches, shears and planer, and further on is the saw mill and lumber yard. On the northern side of the island it is proposed to lay ways for building wooden vessels. The basin, and large marine railway occupy the eastern side.

SHIP ENTERING CRADLE AT TOWNSEND & DOWNEY SHIPYARD.



MACHINERY AND POWER HOUSE FOR MARINE RAILWAY AT TOWNSEND & DOWNEY SHIPYARD.



PLAN AND ELEVATION OF MARINE RAILWAY, BUILT BY H. I. CRANDALL & SON CO. FOR THE TOWNSEND & DOWNEY SHIPYARD.

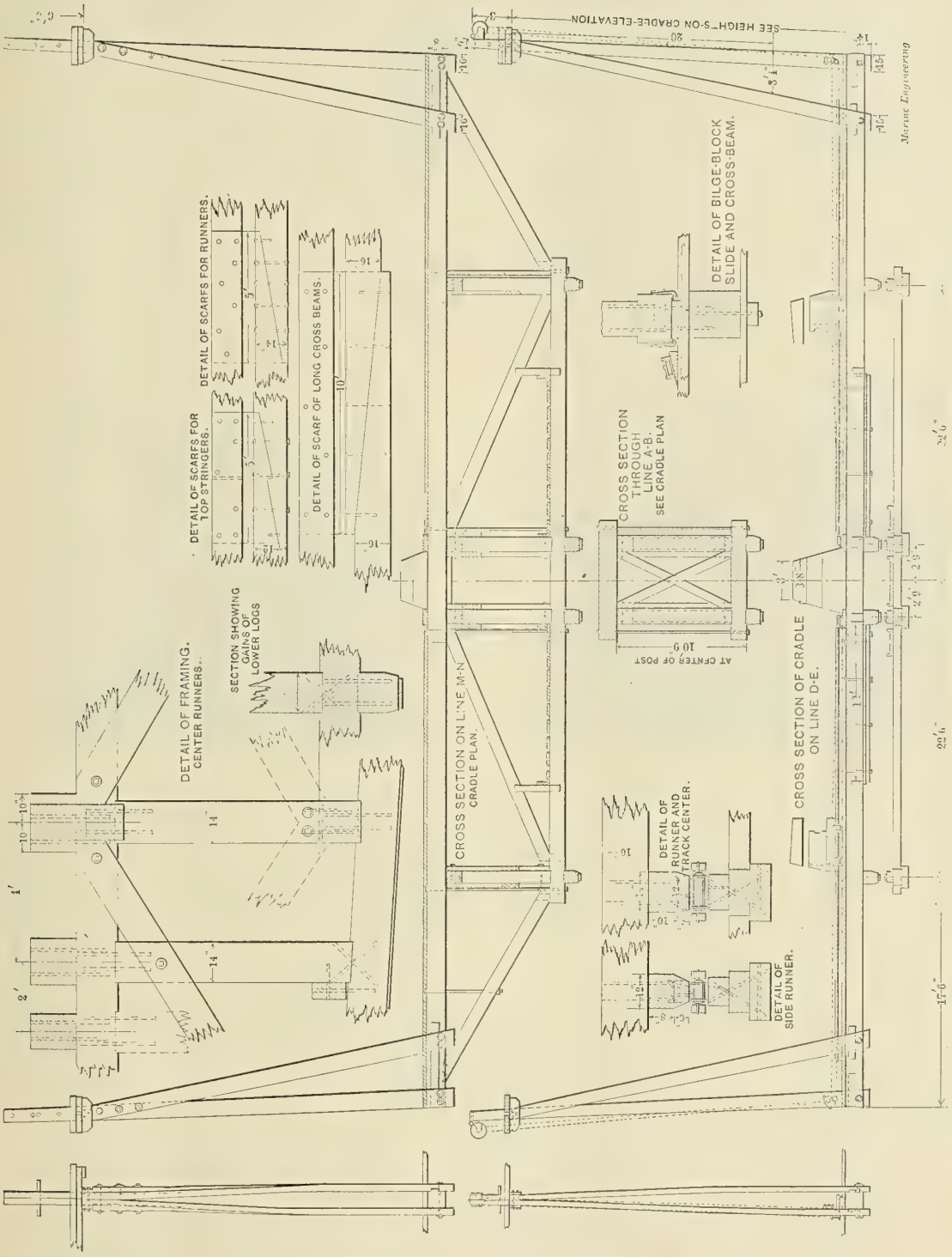
The yard is laid with fire mains, compressed air pipes and electric wiring, and hydraulic power will soon be used in operating the 40-ton cranes in the boiler shop. Large enough for present needs, there still remains sufficient easily reclaimable ground within the bulkhead lines to meet future developments. The company is prepared to do all classes of work in metal and wood, and though it is likely that in time a specialty will be made of large work, at present it is building chiefly smaller boats such as yachts, launches and ferry boats.

Marine Railway at Shooters Island.

While the dimensions and capacities of new dry docks have been steadily increasing during the past few years, to meet the demands of larger ships, so also has the marine railway been improved and enlarged until to-day it is no longer considered a makeshift substitute for a dry dock. The plans and construction have been so carefully worked out and the equipment is so complete, that it is now recognized as a safe form for dry docking vessels up to 4,000 tons.

The new marine railway here illustrated was designed and built by H. I. Crandall & Son Co., engineers, East Boston, Mass., for the Townsend & Downey Shipbuilding and Repair Co., of Shooters Island, N. Y. It is located at the eastern end of the island in a fine still water basin, 600 ft. wide by 1,000 ft. long, with long piers on either side.

The cradle is 320 ft. long on the keel block, 80 ft. wide and is capable of hauling, with an auxiliary trailer, a ship 400 ft. long and of 4,000 tons. The floor of the cradle, 80 ft. by 320 ft., is practically on a level with the

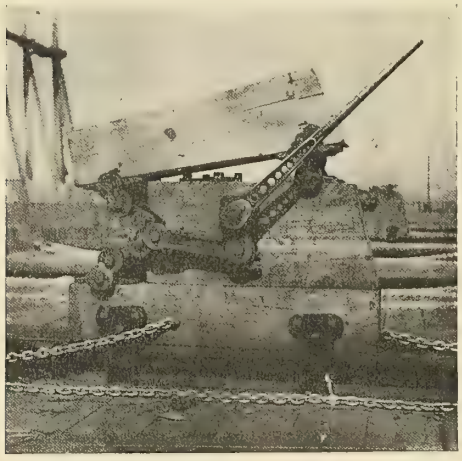

SEE HEIGHTS ON CRADLE-ELEVATION
DETAIL OF BILGE-BLOCK SLIDE AND CROSS-BEAM.
DETAIL OF SCARFS FOR RUNNERS.
DETAIL OF SCARFS FOR TOP STRINGERS.
DETAIL OF SCARF OF LONG CROSS BEAMS.
CROSS SECTION THROUGH LINE A-B. SEE CRADLE PLAN
AT CENTER OF POST
SECTION SHOWING GAINS OF LOWER LOGS
DETAIL OF FRAMING. CENTER RUNNERS.
CROSS SECTION ON LINE M-N CRADLE PLAN.
CROSS SECTION OF CRADLE ON LINE D-E.
DETAIL OF RUNNER AND TRACK CENTER.
DETAIL OF SIDE RUNNER.
Marine Engineering

DETAILS OF CONSTRUCTION OF CRADLE, TRACK AND RUNNERS OF MARINE RAILWAY, BUILT BY H. I. CRANDALL & SON CO.

pier alongside, from which timber, plates, shapes, etc., are handled most conveniently. The keel blocks are spaced 4 ft. apart and give 4 to 5 ft. of height under the flat bottom of a ship. This, together with the open sides of the cradle, makes the space under the ship light and airy for working. There are thirty-six patent Crandall releasing bilge blocks, operated from the side platforms. At mean low tide there is 13 ft. of water over the forward bilge blocks and 17 ft. aft, and at ordinary high water the forward blocks are submerged 17 ft. and the after ones 21 ft.

The tracks and cradle are built throughout of Georgia long leaf pine The inclination of the tracks is 1 to 20, the main body of the cradle is level, and the forward end is parallel to the tracks. The keel blocks have an inclination of 1 to 75.

There are four tracks or ways 800 ft. long under the cradle. The two center ones, placed 5 ft. 6 in. apart, are heavily railed to carry the main load, and the two side ways are 45 ft. apart to carry the cradle and bilge



CRANDALL RELEASING BILGE BLOCK OPEN.

loads. The tracks rest on foundations of spruce piling driven through 25 ft. of stiff red clay and sand to hard bottom, each pile driven to the refusal of a 3,000 lb. hammer falling 18 ft.

The machinery for hauling out the cradle consists of a pair of coupled horizontal engines with cylinders 20 in. dia. by 24 in. stroke, supplied with steam from two horizontal tubular boilers 5 ft. 6 in. dia. and 16 ft. long. The engines drive through a train of heavy gearing four steel chain wheels, on each of which is a 2 1-2 in. iron endless chain. These chains are arranged with gear for equalizing the load, thus preventing any one chain from receiving more than its due share of the load. The machinery rests on foundations of concrete over nests of piling. The time actually required for recently hauling out a ship of 3,800 tons was 29 min., and for a ship of 1,200 tons, 13 min.

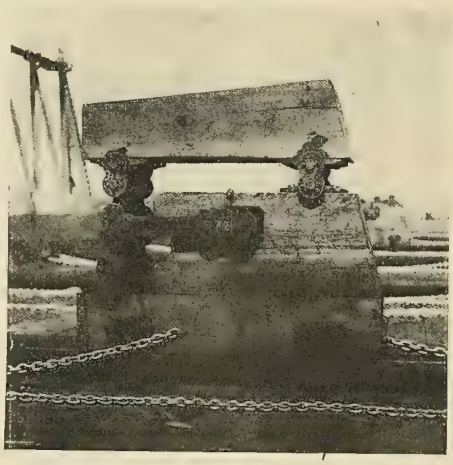
MERCANTILE AUXILIARIES.—After the reading of a paper on this subject by Lord Brassy before the Institute of Naval Engineers at Glasgow, a resolution was passed petitioning the Admiralty to consider the formation of an effective merchant auxiliary fleet. The present sum paid to the owners of the reserve fleet is $300,000, or only one-five-hundredth of the amount of the naval appropriation.

THE STANDARDIZATION AND CONTRACT TRIALS OF THE U. S. TORPEDO BOATS BAGLEY AND BARNEY.

These boats were built by the Bath Iron Works, of Bath, Me., on their own design, the contract price of each being $161,000, and the required speed 28 knots maintained for two consecutive hours. The principal dimensions are:

Length on load water line	157	ft.
Beam, extreme molded	17	ft.
Displacement	167	tons
Capacity of coal bunkers	48	tons
Capacity of reserve tanks	5.25	tons

The engines and boilers are of the Normand type. The engines are inverted, direct acting, triple expansion, the diameters of cylinders being: H. P., 17.22 in.; M. P., 24.76 in.; L. P., 37.37 in., and stroke, 21 in. The cylinder walls, heads and covers are steam jacketed, there being a continuous flow of boiler steam from



CRANDALL RELEASING BILGE BLOCK CLOSED.

H. P. to L. P., which, after leaving the L. P. cylinder jacket, is used to run the fire room blower engine located in the same compartment. The H. P. and I. P. cylinders are each fitted with one piston valve and the L. P. with a double ported slide valve, all worked by Stephenson's link motion through bell crank levers. The sequence of cranks is: H. P., I. P. and L. P. Each engine is fitted with a separate condenser of 1,183 sq. ft. of cooling surface, located in the same compartment. Circulating pumps are fitted but are only used when at anchor or when getting under way, the injection water being forced through the condensers by the motion of the boat. One air pump, two main feed pumps and one bilge pump are driven direct from each of the main engines through cast steel levers keyed to a forged steel shaft, which is in turn worked by a cast steel lever from the intermediate crosshead. The pumps are located on the inboard side of each engine and are readily accessible.

The main feed system as installed on these vessels consists of two main feed pumps for each engine and boiler, which deliver the feed water through heaters of the "dead end" type, one being located in each engine room. The feed from the forward condenser is returned to the forward boiler, and from the after con-

denser to the after boiler. The main and auxiliary steam pipe arrangement is similarly divided, the forward boiler supplying the forward engine and the after boiler the after engine, thus making two independent units of the propelling machinery. By pass pipes are also fitted in both steam and feed systems, so that it is possible to pump from either set of pumps to either boiler or supply steam to either engine from either boiler.

The machinery space is divided into four compartments. The fire rooms, each containing one boiler with pipes, blower and auxiliary feed pump, are located forward and aft of the engine rooms. The engines are also located in separate compartments, the starboard engine being forward and the port engine aft.

The boilers are designed for a working pressure of 230 lb. per sq. in. The principal data for one boiler are as follows:

Heating surface	2,776.19 sq. ft.
Grate area	59.37 sq. ft.
Ratio of H. S. to G. S.	46.76 sq. ft.
Length of grate	9.5 ft.
1,552 tubes, average length 71.5 in., outside diameter 1 3-16 in., No. 11 B. W. G.	
Weight of water	6,817 lb.

The propellers are of Hyde manganese bronze, secured to the shaft by taper fit, key and a bronze nut:

Number of blades	3
Diameter	6 ft. 8 in.
Pitch (mean)	10.96 ft.
Developed area	14.66 sq. ft.
Disk area	27.83 sq. ft.
Projected area	14.66 sq. ft.

The standardization trial of the *Bagley* took place May 14 over a measured course at Southport, Me. Four double runs were made at speeds between 22 and 28 knots. As a result of these trials it was found from the speed revolution curve that 297.6 revolutions would produce a speed of 28 knots. On the morning of May 16 this boat left the Bath Iron Works for her contract trial of two hours at sea. The start was made at 11.30 A. M. The performance of the boat under way was admirable, and, unlike vessels of this type, the vibrations of the hull were very slight, a slight tremor being noticeable at about 22 knots, which rapidly disappeared at the higher speeds. The engines worked very satisfactorily during the trial. No water, except the regular circulation through the main bearing brasses and thrust bearing, was used on any of the bearings. The revolutions were observed at intervals of five minutes, the steam, air pressure and temperature, every fifteen minutes.

DATA OF TRIAL.

WEIGHTS.

Hull	45.00 tons
Machinery	90.12 tons
Trial load	27.00 tons
Mean draft, beginning	4 ft. 11 5-8 in.
Mean draft, end	4 ft. 9 3-4 in.
Displacement, beginning	171.3 tons
Displacement, end	163.5 tons
Wetted surface	2,539 sq. ft.
Immersed midship section	56 sq. ft.
Condition of wind	light
Condition of sea	long swell

AVERAGE STEAM PRESSURES PER GAGE.

Main steam	214 lb. per sq. in.
H. P. Receiver	209 " " "
M. P. Receiver	82 " " "
L. P. Receiver	23 " " "
Vacuum	22 in.
Air pressure in fire room in inches of water	6 "

TEMPERATURES.

Injection	50°
Discharge	82°
Hot well	100°
Feed	232°

REVOLUTIONS OF MAIN ENGINES PER MINUTE.

Starboard	305.75
Port	312.48
Mean	309.12
I. H. P. developed on trial	4,300
Coal burned per hour	8,077 lb.
Coal burned per I. H. P. per hour	1.88 lb.
Coal burned per sq. ft. grate per hour	68 lb.
Average speed for two hours	29.15 knots
Maximum observed speed for five minutes	30.2 knots
I. H. P. per ton of machinery, including water	47.7

The official trial of torpedo boat *Barney* took place May 14, 1901. The sea was rather rough for a trial of a vessel of this type. This vessel was required to make 301.35 revolutions per minute for a speed of 28 knots. The average speed actually maintained for two hours was 29.04 knots, an increase of 1.04 knots over contract requirements. The structural data given for the *Bagley* applies also to the *Barney*, as the boats are identical in design.

SHIPPING PROPELLER SHAFT AT SEA.—The captain of the steamer *Kaga Maru*, which recently arrived at Victoria, B. C., reported meeting the Norwegian steamship *Guernsey* while undergoing extensive repairs in mid-Pacific. The *Guernsey* had lost her propeller and propeller shaft and new ones were substituted. The cargo was shifted forward until the bow was deep in the water and the stern elevated, so that the stern tube was out of the water. The sea was calm, and by improvised rafts and rigging the spare shaft was placed in position without much difficulty. The four-bladed spare propeller was too heavy to be handled, and was only shipped after two of the blades had been cut off to lighten it.

AMERICAN SHIPPING.—On June 30 the Bureau of Navigation reported that during the month of June, 149 sail and steam vessels of 41,496 gross tons were built in the United States and officially numbered. The report for the twelve months shows that 1,173 sail and steam vessels were built and numbered. This tonnage is divided as follows: Atlantic and Gulf, 735 vessels of 190,948 gross tons; Pacific, 151 vessels of 46,105 gross tons; Great Lakes, 105 vessels of 153,138 gross tons; western rivers, 182 vessels of 11,094 gross tons. During the corresponding year ending June 30, 1900, 1,058 sail and steam vessels of 305,677 gross tons were built and numbered in this country. These figures do not include unrigged vesseels. This increase of nearly 100,000 tons is made up of approximately the following percentages of increase in the four districts, over their respective outputs of last year: 19 per cent. on the Atlantic and Gulf, 23 per cent. on the Pacific, 54 per cent. on the Lakes and 31 per cent. on the western rivers.

STEAMSHIPS INCHMARLO AND INCHDUNE.

That the subject of steam economy is receiving close attention by ship owners is shown in the designs of engines and boilers of the steamships *Inchdune* and *Inchmarlo* of the Inch Line, owned by Hamilton, Fraser & Co., of Liverpool. It has been the policy of this company to make use of every available and assured economy in boiler and engine room equipment, in the many ships of their line, and in the last two mentioned, results have been obtained which surpass any records known. The unprecedented coal consumption of .97 lb. per indicated horse power was maintained on the trial trip of the *Inchmarlo* from West Hartlepool to Dover, a distance of over two hundred miles.

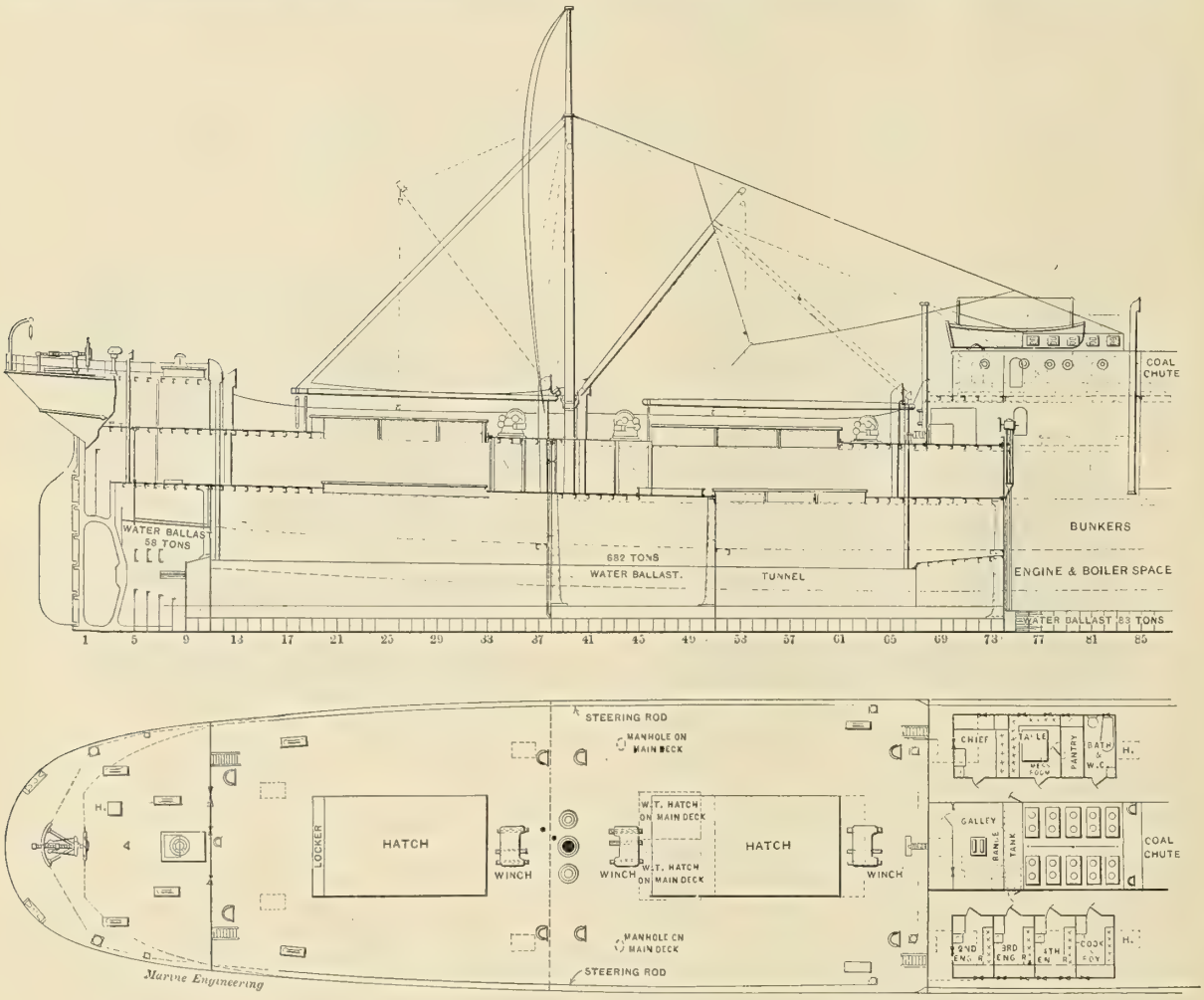
These ships were built by W. Gray & Company, West Hartlepool, England, and are of the usual heavy and rough tramp type. The principle dimensions are:

Length over all	370 ft. 0	in.
Length between perpendiculars	360 ft. 0	in.
Beam extreme	48 ft. 0	in.
Depth moulded	29 ft. 0	in.
Launching draft	6 ft. 2 1-4	in.
Launching displacement	1,990	tons
Load draft	22 ft. 9 1-2	in.
Load displacement	8,898	tons
Block coefficient	.8	
Area midship section at load draft	1,051	sq. ft.
Tons per inch at load draft	35.5	tons
Net tons	2,636	tons
Gross tons	4,078	tons

Water ballast extends from the forward peak tank to the after engine room bulkhead, except for a space of 16 ft. in the boiler room, and contains 498 tons of salt water. The capacity of the forward peak tank is 66 tons and the after one 58 tons. Between the two after holds is a deep well for 682 tons of water ballast. The cargo capacity of the four holds and deep well, for grain is 212,482 cu. ft. and for bales 119,038 cu. ft., and the capacity of 'tween decks, poop, bridge and compartment forward of collision bulkhead is 143,849 cu. ft. for grain and 131,034 cu. ft. for bales. Wing bunkers for stowing 383 tons of coal extend up to the spar deck abreast the engine and boiler rooms.

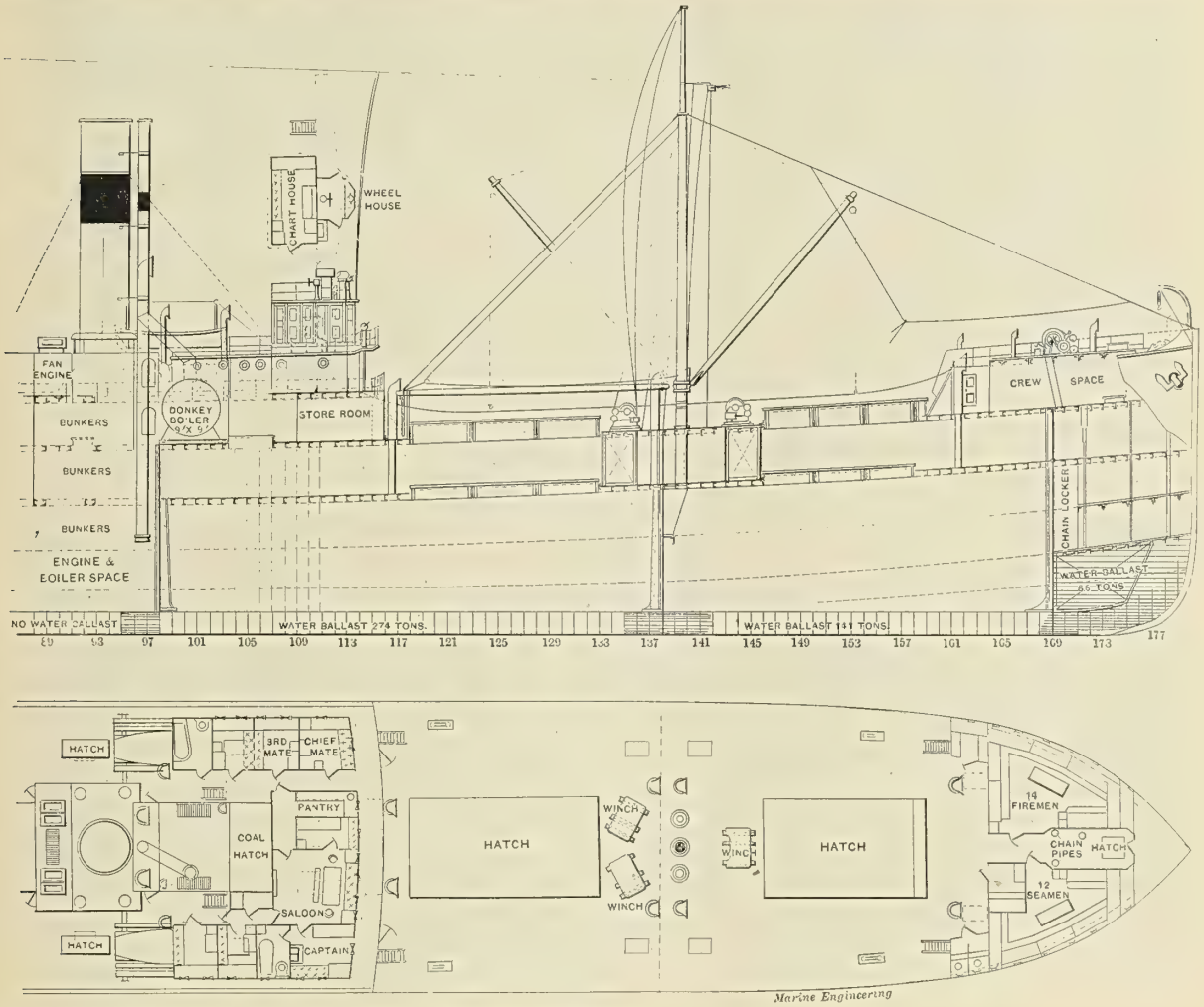
There are four large cargo hatches, the end ones being served by one boom each, and the middle ones by two booms each. Each boom has a steam winch.

The officers' quarters are located in steel houses on the bridge deck and the crew are in the forecastle. The general arrangement is well shown on the inboard profile and deck plan given on pages 332 and 333.



LONGITUDINAL AND DECK PLAN OF STEAMERS INCHDUNE AND

The design and construction of the engines and boilers were carried out by the Central Engineering Works, West Hartlepool, who are among the leading engineers adopting modern methods. From extensive experience with other marine engines they believe that the coal consumption can be largely reduced by adopting superheated steam, induced draft, and proper steam expansion, besides carefully attending to the design of auxiliaries. The remarkable results obtained speak for themselves. Superheated steam has been the general practice in stationary engineering throughout Europe for several years, and our own engineers through the



INCHMARLO BUILT BY W. GRAY & CO., WEST HARTLEPOOL, ENGLAND.

discussion at the recent meeting of the American Society of Mechanical Engineers, are realizing the economies possible in this direction. In marine practice the superheater has been used but little, and then generally in the form of a drum placed in the uptake or around the stack.

The engines of these single screw ships are illustrated on pages 334 and 335, and are of the inverted, direct acting, quadruple expansion, five cylinder, five crank type.

The diameters of the cylinders are: 17 in., 24 in., 34 in., 42 in. and 42 in., by a common stroke of 42 in. The arrangement of cylinders on the *Inchmarlo* from forward aft is: H. P., No. 1 I. P., For. L. P., No. 2 I. P., Aft L. P. The sequence of cranks looking aft is H. P., No. 2 I. P., For. L. P., No. 1 I P., Aft L. P. The crank angles are 72 deg.

By this arrangement the maximum rocking moment about the third cylinder, the For. L. P. is 55 foot tons at the top and 34 foot tons at the bottom, which is a reduction of over one-third the rocking moments of five-cylinder engines previously built by this company of the same dimensions, but with different arrangement of cylinders. In these former engines the No. 1 I. P. was forward, the H. P. next, and the other three cylinders came in the same order. The sequence of cranks was: No. 1 I. P., Aft L. P., No. 2 I. P., H. P., For. L. P

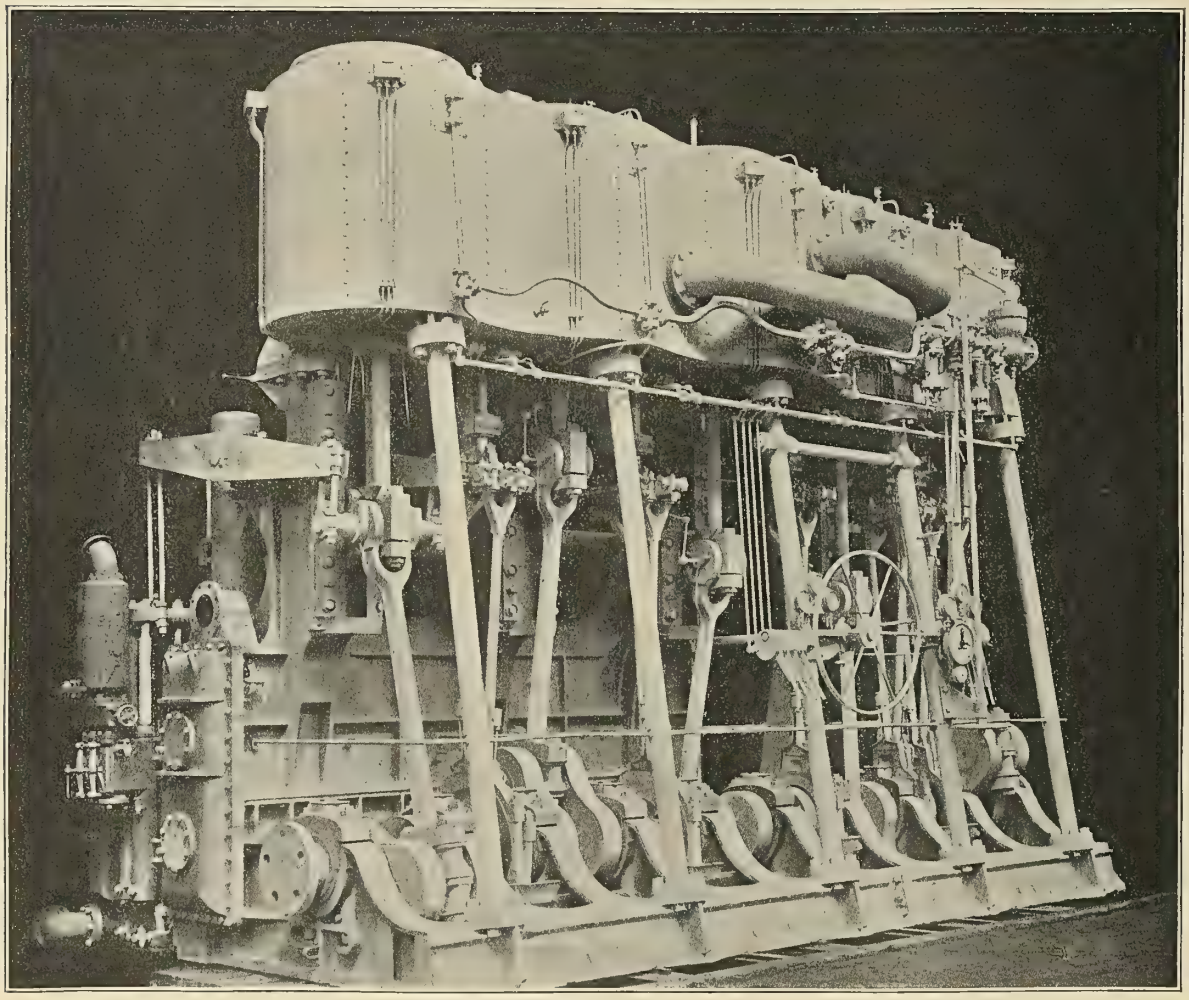
All cylinders are fitted with liners, the high pressure valve is of the piston type and the four others are of the customary slide valve pattern. The compactness of cylinders allows a simple system of steam jacketing to be used on top, bottom and sides, and above and around this is fitted a heavy lagging of asbestos. The lagging on top can be readily removed for access to the cylinders and valve chests. "Central" steam traps are used throughout.

The engine bed, rear columns and condenser are of cast iron, and the front columns are of wrought iron. The crankshaft is built in five sections.

Most of the economy in steam consumption has been effected in the boiler room, however, by the use of the Ellis & Eaves induced draft fittings and the "Central" superheater, both manufactured by the engine builders. There are two boilers, placed thwartships, 13 ft. dia. by 10 ft. 6 in. long of the ordinary single ended Scotch type and carrying steam at 267 lb. pressure. Each boiler has three furnaces 39 in. outside dia. and 7 ft. 1 1-2 in. long with independent combustion chambers and 187 Serve tubes 3 1-4 in. dia. The grate surface for both boilers is 86 sq. ft., and the heating surface 2,890 sq. ft.

Steam from the boilers enters the superheaters at the top through a series of headers, as illustrated in detail on page 337. The waved form of tubes agitates the steam and brings each particle against the surface, to absorb more and more heat in descending the tubes to the hottest part of the uptakes. There it is collected by headers and lead to the engine.

To make the use of high pressure steam a success, it is first necessary to carefully cover the boiler and all



FRONT VIEW OF FIVE CYLINDER QUADRUPLE EXPANSION ENGINE FOR S.S. INCHMARLO.

By the use of Serve tubes the size of boiler has been cut down, which means a large saving of weight as the shell is 1 19-32 in. thick.

The arrangement of the boiler room with superheater, and induced draft system, is shown on page 336. Air for the furnaces is drawn in through slides at the front of the nests of tubes on the spar deck, and heated by the tubes in its downward path to the ducts *B*. By these ducts it is carried to the furnaces, where it enters above and below the grates and is controlled by dampers. The gas, upon reaching the uptakes, strikes upon the steam superheating tubes, and surrounds them for a distance of over 13 ft. where at the spar deck it passes through the air heating tubes above referred to, is drawn into the exhaust fans, and discharged into the stack.

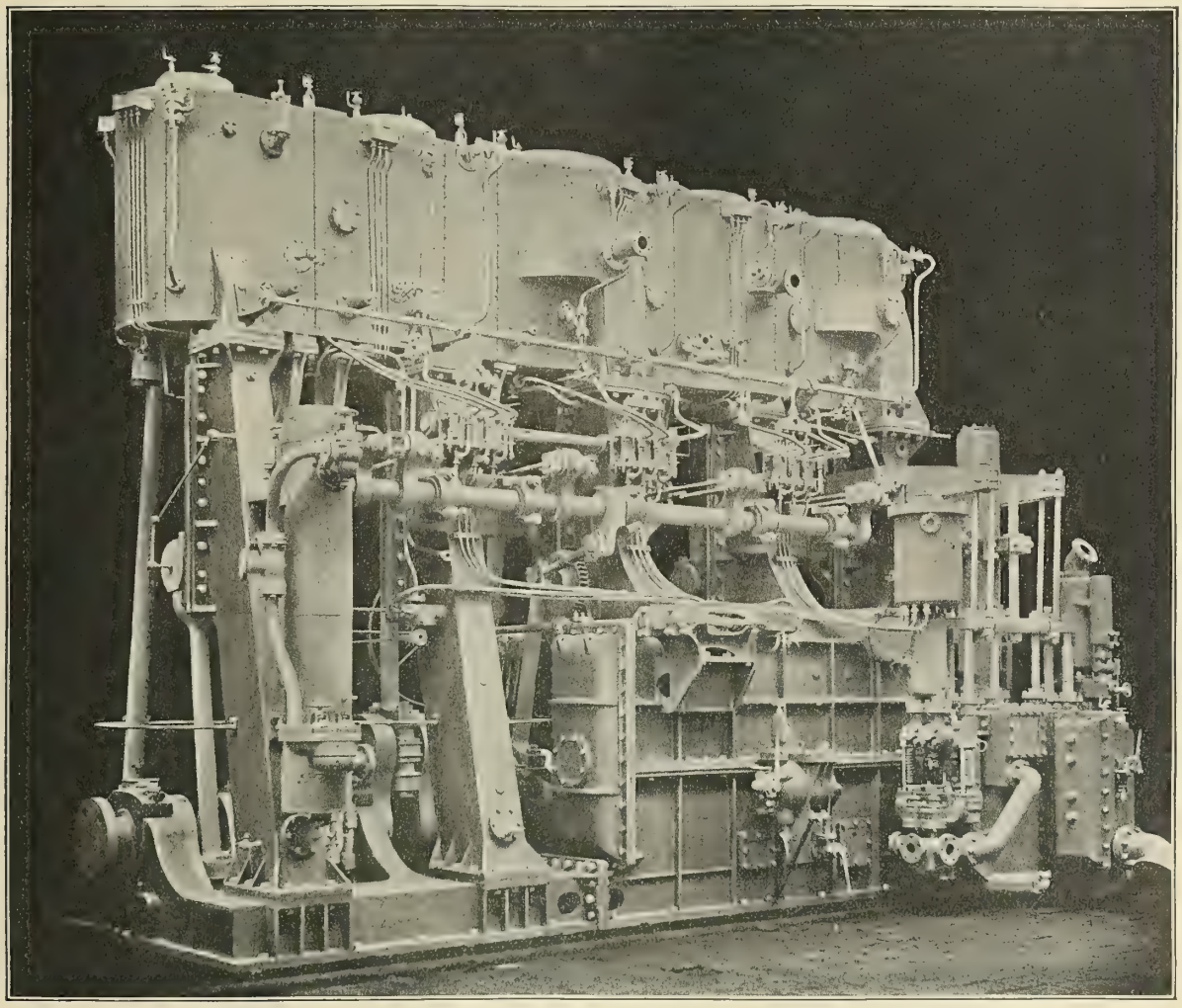
steam piping, for radiation losses are large at these pressures; and second, to provide a means of properly filtering the feed water and heating it to nearly the temperature of the boiler, to protect the boiler from oxidization or scale, and severe strains set up by unequal temperatures. On these steamers this is done by first pumping the feed water from the hot well through filters into a Weir contact heater, where the temperature is raised to 210 deg. and where the air is removed, and then pumping it to the boilers through a surface heater, which raises the temperature to 370 deg.

Turning now to the trial trip data, we will first note the temperature of the water and steam at the different stages. The temperature of the hot well was 96 1-2 deg.,

inlet to the contact heater 113 deg., outlet 209 deg., outlet from surface heater 370 deg., temperature of steam 412 deg. In the superheater the steam was raised to 469 1-2 deg., but lost by radiation in passing to the high pressure steam chest 22 1-2 deg. The air for the furnaces is heated from 53 deg. to 299 deg. The decrease of temperature of the waste gas is also striking. Entering the uptakes at 620 deg. it drops to 543 deg. upon leaving the superheater, and to 404 deg. by passing through the air heating tubes.

The propeller has four blades, is 16 ft. dia., 14 ft. 6 in. pitch, and has an area of 85 sq. ft. The pitch ratio is 1.103, the ratio of midship section area to propeller area 12.36.

Draft forward	10 ft. 4 in.
" aft	15 ft. 5 in.
" mean	12 ft. 10 1-2 in.
Reversing and expansion gears	Full out
Intermediate stop valve on engine	Full open
Steam stop valves, to and from superheater	3-4 open
Pressure of steam in No. 2 cylinder jacket and covers	103 lb.
Pressure of steam in Nos. 3 and 4 cylinder jacket and covers	68 lb.
Temperature of superheated steam in jacket coil of No. 2 receiver chest	470 deg. Fahr.
Feed temperatures—hot well	96 1-2 deg. Fahr.
Inlet to contact heater	113 deg. Fahr.
Outlet from contact heater	209 deg Fahr.
" " surface heater to boilers	310 " to 370 deg. F.
Temperature of sea water	54 " Fahr.
" discharge	97 " "
Temperatures, deck	53 " "
" engine room	75 " "
" stokehold	77 1-2 deg. Fahr.
Heated air entering furnaces	299 deg. Fahr.
Waste gases below superheater	620 " "
" " above superheater	543 " "
" " " heating tubes	404 " "
" " at fan discharge to funnel,	319 " "
Steam at inlet to superheater pipes (267 lb.)	412 " "
" after passing through superheater	469 1-2 deg. Fahr.
Total superheat above temperature due to boiler pressure	57 1-2 " "
Steam at high pressure steam chest	447 " "

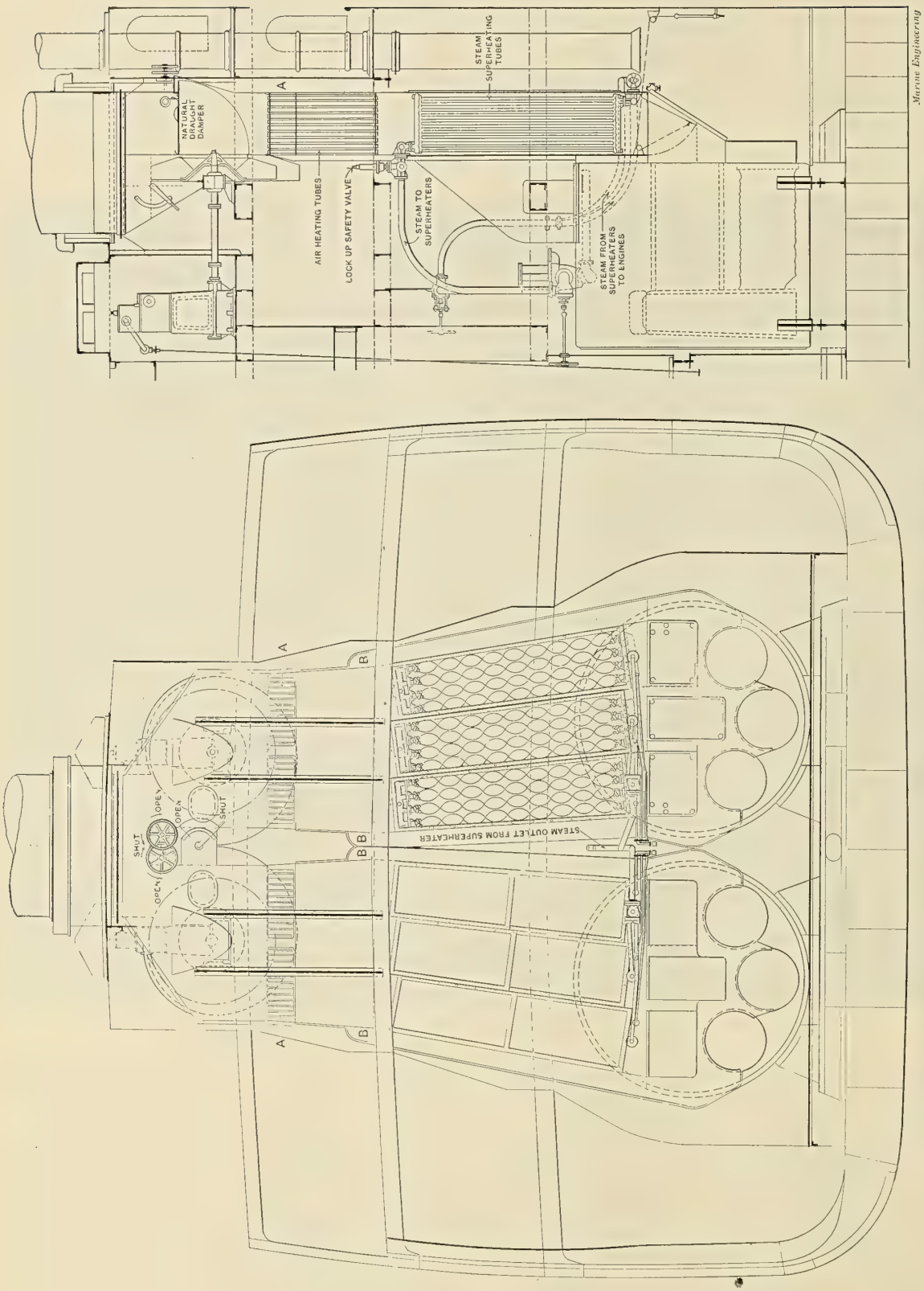


REAR VIEW OF ENGINE BUILT BY THE CENTRAL ENGINEERING WORKS FOR S.S. INCHMARLO

The weights of machinery are as follows:

Engine	109 tons
Shafting and propeller	36 1-2 tons
Boilers and mountings, complete	93 1-2 "
Uptakes, casings, air heaters, superheaters and fans	35 1-2 "
Funnel	6 "
Engine and boiler room auxiliaries	49 "
Spare gear	7 "
Water in boilers and engines	38 "
	373½ tons

The trial trip was run in ballast trim on October 26, 1900, when the following data were recorded:



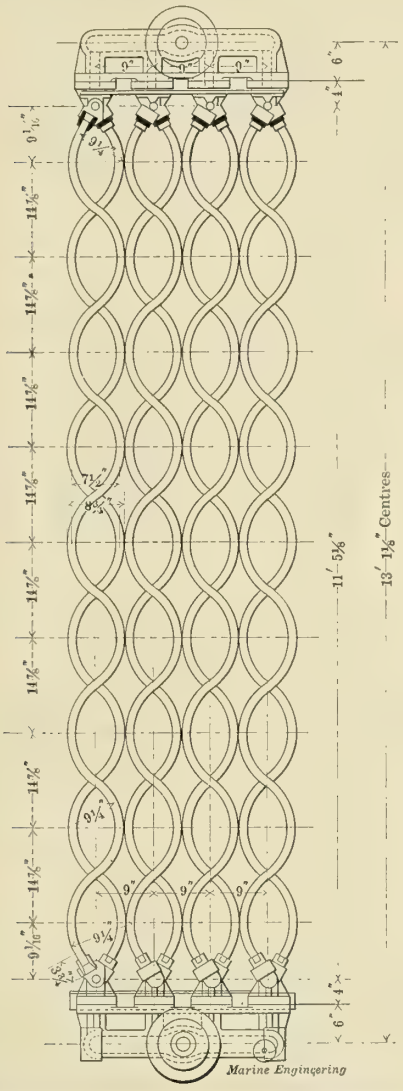
ARRANGEMENT OF BOILER ROOM ON S.S. INCHMARLO, SHOWING JOHN BROWN & CO.'S ELLIS & EAVES INDUCED DRAFT, AND "CENTRAL" SUPERHEATERS.

The total power developed was 1,627 I. H. P. at 80 rev. of the engines, and was divided among the cylinders as follows:

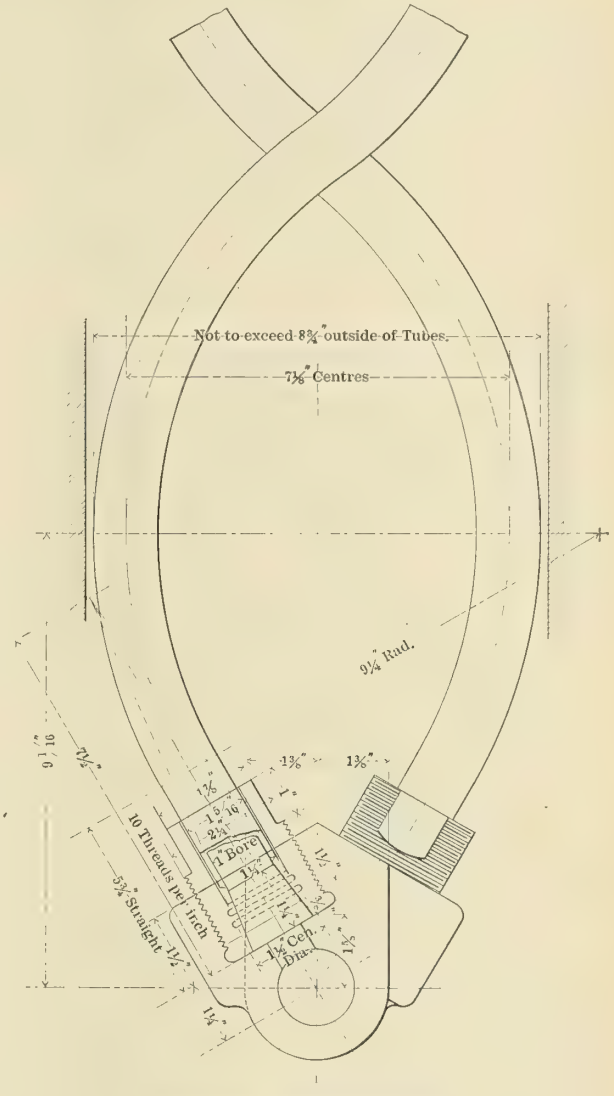
	H.P.	1st I P.	2d I.P.	No. 1 L.P.	No. 2 L.P.
Indicated H. P.....	283	359	300	329	356
Mean effective pressure, lb.	75.3	47.8	20.0	14.4	15.5
Range of temperature, deg.....	56.	59.	45.5	107	109

No attempt was made on the trial to balance up the power of the different cylinders. The mean effective pressure reduced to the low pressure cylinders was lb. These figures for actual results, obtained under usual conditions of service, are remarkably good, and when it is remembered that the coal bill of the steamship companies amounts to about one-third the total expenditures, it is evident that the saving of from .2 to .5 lb. of coal per I. H. P. will make a great reduction in annual expenses. The builders and engineers are to be congratulated for these highly satisfactory performances.

The illustrations on pages 334 and 335 are reproduced from London *Engineering*.



ARRANGEMENT OF TUBES FOR "CENTRAL" SUPERHEATER.



DETAIL OF TUBES AND HEADER.

35.50 lb. From the combined card diagram the card factor is found to be 89.7 per cent; i. e., the ratio of the actual area to the theoretical.

Wallbottle coal was used, which is not equal to the best Welsh grade, but the lb. per I. H. P. reduces to .97 lb. While running in service, the ship makes 9 knots at load draft, with 67 turns of the engine developing 1,440 I. H. P., and the consumption with ordinary coal is 1.15 lb. per I. H. P. This gives one ton of displacement carried one mile on .0207 lb. coal, and one ton of dead weight carried one mile on .0298

New Lake Steamers.—The American Shipbuilding Company have contracted to build three freight steamers similar to the *Mars* for the Mutual Transportation Company. They will be 366 ft. over all, 346 ft. keel, 48 ft. beam and 28 ft. deep.

Shallow Draft Gunboat.—The shallow draft gunboat *Teal* built by Yarrow & Co. to the order of the British Admiralty made a speed of 13 knots on a draft of 2 ft. 3 in. The vessel is 160 ft. long; 24 ft. 6 in. beam, and is propelled by two sets of compound engines. The propellers revolve in longitudinal tunnels.

STABILITY OF STEAMERS AFTER COLLISION AT SEA.*

BY M. BERTIN.

(*Continued from page 272.*)

The experiments made on the model arranged to represent these new conditions led to the following results for the damages referred to in Tables VI, VII, VIII:

TABLE IX.—D_1, D_2, D_3, D_4, D_5 open to water.

	Full load.	Half load.	Light.
i. Initial inclination for equilibrium	9°	11 1-2°	0°
$\rho_i - a$. Initial metacentric height	1.67 ft.	.69 ft.	.98 ft.
$(\rho_m - a) \sin \theta_m$. Maximum stability arm	.40 ft.	.26 ft.	.07 ft.
θ_m. Inclination corresponding to this maximum	15°	17°	4°
θ. Angle of vanishing statical stability	31°	27°	9°
ϕ. Angle of dynamic stability	8 1-2°	9°	2°
ϕ_1. Same angle referred to ship intact	7°	7°	2°

TABLE X.—D_1, D_2, D_3 open to water.

	Full load.	Half load.	Light.
i. Initial inclination for equilibrium	4 1-2°	3°	0°
$\rho_i - a$. Initial metacentric height	2.07 ft.	.92 ft.	.98 ft.
$(\rho_m - a) \sin \theta_m$. Maximum stability arm	.72 ft.	.62 ft.	.30 ft.
θ_m. Inclination corresponding to this maximum	21 1-2°	25°	30°
θ. Angle of vanishing statical stability	42°	21 1-2°	39 1-2°
ϕ. Angle of dynamic stability	11 1-2°	15°	20 1-2°
ϕ_1. Same angle referred to ship intact	10 1-2°	12 1-2°	12°

TABLE XI.—D_1 alone open to water.

	Full load	Half load.	Light.
i. Initial inclination for equilibrium	1°	1°	0°
$\rho_i - a$. Initial metacentric height	2.76 ft.	1.61 ft.	.98 ft.
$(\rho_m - a) \sin \theta_m$. Maximum stability arm	1.05 ft.	.98 ft.	.69 ft.
θ_m. Inclination corresponding to this maximum	26 1-2°	28 1-2°	30 1-2°
θ. Angle of vanishing statical stability	50 1-2°	48 1-2°	45°
ϕ. Angle of dynamic stability	14°	16 1-2°	19 1-2°
ϕ_1. Same angle referred to ship intact	13 1-2°	16°	17 1-2°

Tables IX, X and XI, would carry the increase of draft of water, in the case of Table V to 18 or 20 in. To this sinking of the vessel entire, which immerses the breach prouced in the upright position, a second is added in the case of damage, which is due to the inclination, and which is still more serious. In effect, in Table V, in considering only the half load condition we find an inclination of 14 deg., while according to Tables IX, X and XI, we were assured that the inclination nothing for light condition would not exceed practically 3 1-2 deg. In Table VIII also the inclination is 3 1-2 deg. only for the half load condition. The system of bulkheading adopted diminishes then by 10 deg. in round numbers, the inclination of the ship after damage, which raises the lower edge of the breach by about 4 ft. 7 in. in comparison with the load water line.

If we apply to these tables the remarks made in reference to the Tables VI, VII and VIII, we find that the ship is presented under reassuring conditions of security.

It remains to make a last observation, which has its importance, on the subject of the efficiency of the measures of proposed security, such as are expressed by the two preceding series of tables.

In all that precedes there has never been a question of the flotability, the study of which has long wrongly taken the place which belongs to the study of stability, but of which the role is not however negligible. Now the invasion of the central compartment of the hull *A*, the bulkheading of which preserves the ship as a whole, would produce an increase in the draft of water, which should be 15 in. at the least.

The invasion of the lateral compartments *B* and *B'*, which the form of the protective deck shelters, as in

The total elevation of the breach due to these two causes, which is nearly 6 ft., with reference to the surface of the sea, presents the advantage of keeping the upper deck of the between deck bulkheading out of the water, and the main upper deck high enough and sheltered enough from the sea, so that it should be possible to close the breach by such means as might occur. From that time the between deck *E* may contribute to the stability of the damaged vessel.

* A paper read at the Congress of Naval Architects, Paris, 1900.

The conditions of security in which the system of bulkheading places the vessel, when it is possible to arrest the flow of water in the between deck E, have been studied in comparison with those indicated by Table V for the unprotected ship, and with Table VII for the protected ship, but with the second between deck open. To this purpose the model has been arranged with the upper parts intact, the two lateral store rooms B, B' open, and the three compartments D_1, D_2, D_3 open. The results of the experiments are given in Table XII.

TABLE XII.—D_1, D_2, D_3 open to water.

	Full load.	Half load	Light.
i. Initial inclination for equilibrium	4 1-2°	3 1-2°	23°
$\rho_i - a$. Initial metacentric height	2.30 ft.	.75 ft.	1.80 ft.
$(\rho_m - a) \sin \theta_m$. Maximum stability arm	4.43 ft.	2.89 ft.	2.46 ft.
θ_m. Inclination corresponding to this maximum	76°	65°	60°
θ. Angle of vanishing statical stability	Much beyond 90°.		
φ. Angle of dynamic stability	A little beyond 40°.		
φ. Same angle referred to ship intact	A little beyond 40°.		

In the full load and half-load conditions the security is as complete as before damage.

Taking into account what has been said above on the filling of the compartments D, the security is satisfactory, even with the vessel entirely light, and all danger of capsizing is removed.

In beginning a study like this, which necessarily leads to the acceptance of certain detractions from the usual practice in the distribution of space on board passenger ships, I proposed to myself, before all, to remain within the field of practical solution. I made it the rule to avoid all complication of accommodations, all inconvenience of service and even all serious expense or slowness of construction. It remains to indicate how these conditions have been fulfilled.

The form given to the protective deck does not change the height of the hull in the median region and does not reduce the height disposable for the boilers and engines. The capacity of the coal bunkers is too slightly diminished to require note of the change.

The establishment of water-tight trunks around the hatchways over the entire height of the second between deck C introduces no inconvenience, because there is no direct movement either of persons or material between the between deck and the hold. Furthermore, there exist already trunks to isolate the principal passages, those which lead to the engine and boiler rooms. The only complication will result from the necessity of providing the between deck E with small separate loading ports.

It might seem at first view that the additional bulkheads added in the between deck E would render the trunks useless. It is certain that the hatchways are doubly protected against the sea—by their trunks first and then by the bulkheads which envelop them completely. The trunks are, however, indispensable, because they do not have doors like the bulkheads, and because an open door or a badly closed one must always be distrusted.

The establishment of the cellular layer, which on a passenger steamer is more justly called the bulkheaded between deck, brings some changes into the arrangement of the lodgings. It appears possible to fairly balance the inconveniences and the advantages which result.

In a passenger steamer of 10,000 tons, such as that chosen for the subject of study, the second between deck is given up almost entirely to the lodging of third-class passengers, who form an important part of the patronage of steamship companies. The arrangements shown in Figs. 1 and 2 permit of establishing in this between deck 1,800 bunks on the two levels. The disposition of Figs. 3 and 4 removes 230 double bunks, at the same time that it isolates, on the wings a volume of about 43,750 cu. ft. It is necessary to lodge the passengers elsewhere and to utilize otherwise the space removed.

Electric lighting, at present in general use, and the means of artificial ventilation which are available, permit the establishment on a false deck forward of passenger accommodations more comfortable and more healthful than those abandoned in the second between deck. The neighborhood of the forward smokestack would render easy, in particular, the establishment of a continued removal of foul air, which arrangement has been so favorable to health on the national transports and the use of which has been more than once thought of for passenger steamers. The volume to be taken from the cargo holds for 230 double bunks would be about 40,000 cu. ft.

The lateral compartments D of the second between deck will supply commodious baggage rooms, and even very accessible cargo space for packages of moderate dimension. The after cargo hold and the lower floor of the fore hold will easily provide space for all the large packages. The slope of the protective deck has been limited in such a manner as not to obstruct too much the handling of the packages in the compartment D. Without this consideration the deck would have been carried lower.

There is but one word to say regarding the cost of the proposed installations, which would not affect in an appreciable manner a new construction, and would scarcely appear even in a repairing of the shell. It would require at the most some 30 tons of bulkheads, longitudinal and transverse, some dozen tons of trunks and various fastenings and some pipes. The expense would not reach $20,000. The means of handling water in the compartments and the equipment for pumping would, without doubt, have need of some improvements, but this would be a useful expense, even in the absence of the system of bulkheading proposed.

There is still less reason for hesitating on account of the cost of the preparatory study or the delay which it may occasion. The present work undertaken at the end of March was ended before June 1. It occupied for nearly two months a skilled workman and a draftscan, acquainted, it is true, with this kind of work. The methods of calculation for stability have been so perfected, furthermore, that it would be possible to dispense with the model; but it would not result in economy either of time or money. The experimental method, which leaves no place for possible error, seems moreover preferable for researches where human life is in play.

In résumé, there is here encountered neither difficulty nor cause for retardation of construction nor expense which might cause hesitation, even on the basis of the most strict economy.

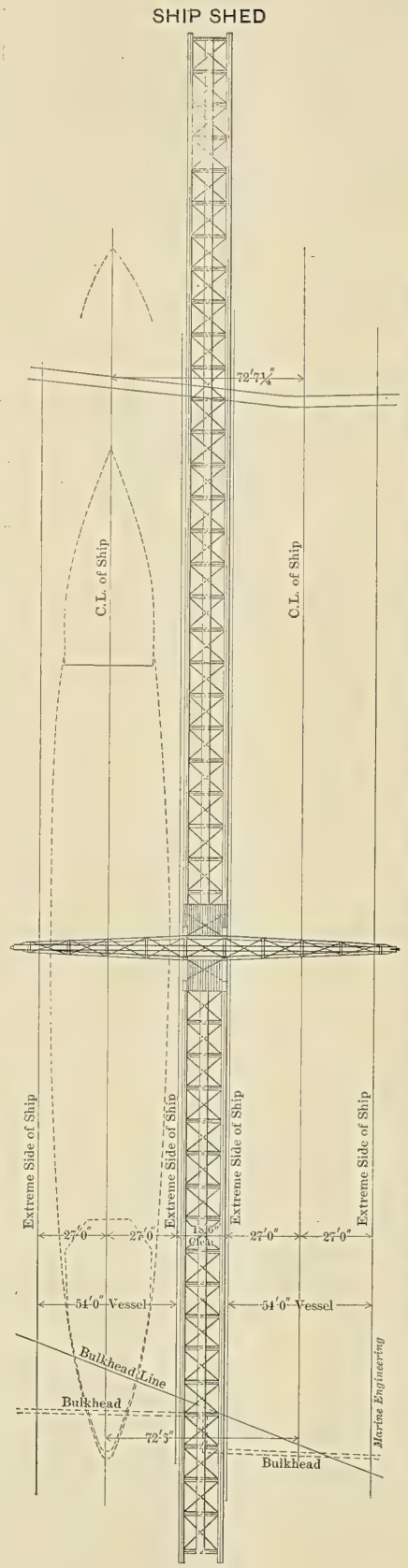
In favor of the adoption of these means of safety is found, aside from the motives of humanity which excel all, the hope of financial success. It might be possible, in fact, that the influx of passengers and the lowering of rate of insurance, the extent of the interests in question being known and appreciated, would be the well-merited recompense of companies which, under a higher inspiration, should take the initiative in providing a guarantee for their ships against the disastrous effect of collisions at sea.

CANTILEVER CRANES AT THE YARD OF WILLIAM CRAMP & SONS' SHIP AND ENGINE BUILDING COMPANY.

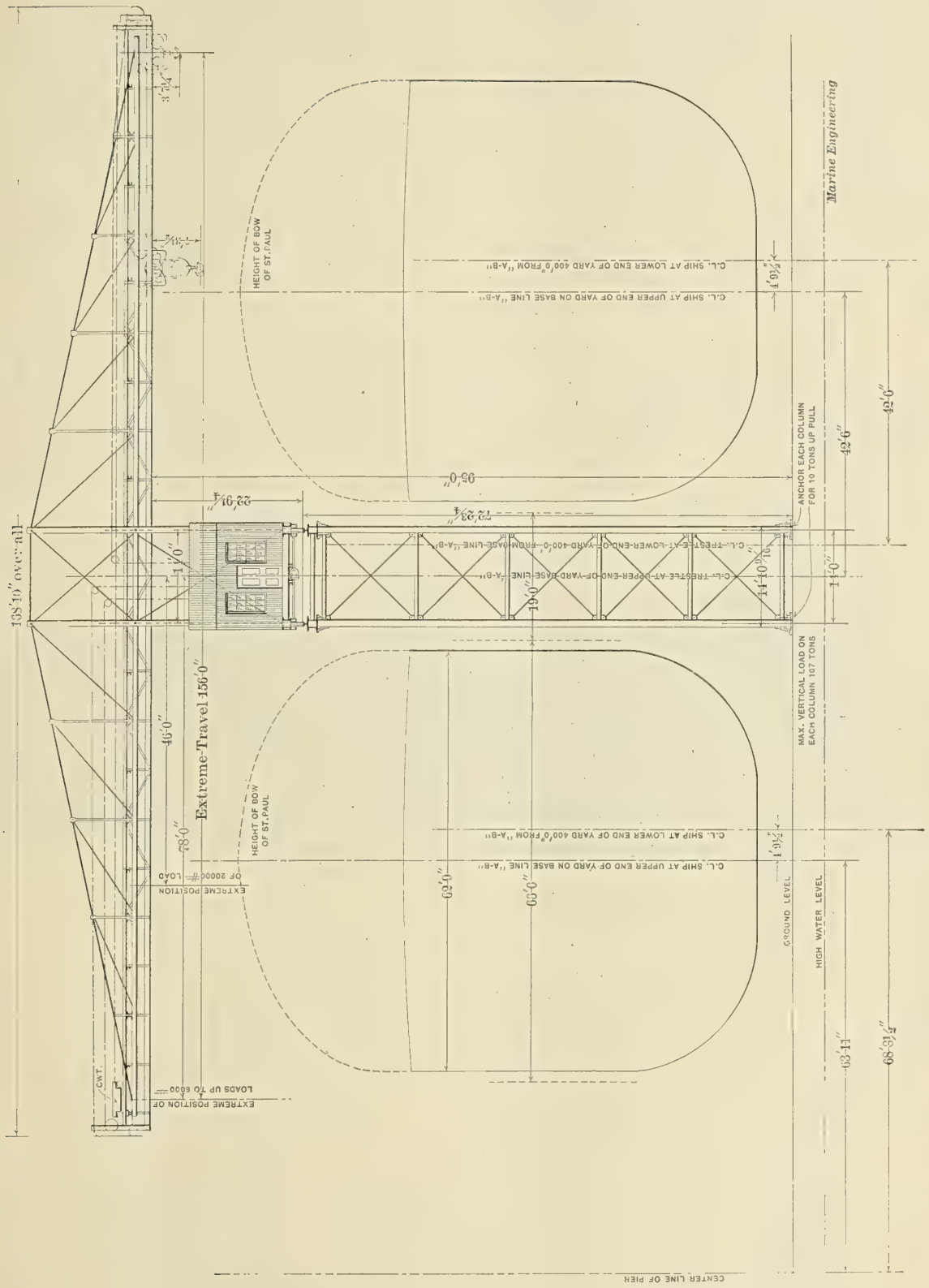
In cutting down the labor in shipyards one of the first items for consideration is the handling of material from the plate shed to its place on the ship under construction. Several forms of electric cranes and steam hoists are in use in the different yards, and among the newest equipment is that installed at the William Cramp & Sons' shipyard. It consists of three cantilever cranes driven by electricity, and covering six shipways.

Each crane is mounted on a specially designed trestle built entirely of steel. The columns are pinned at top and bottom to the bridge trusses and foundations. At the center of each trestle are two main diagonal struts for holding the runway together endwise. These are pinned together and to the trestle at their apex, and to the foundations at their bases, thus making the center of the trestle a fixed point from which expansion and contraction may occur in either direction, due to the pinned connections with the vertical columns.

The carriage for each crane is driven by electricity; the motor with necessary drums, gearing and friction clutches for driving all functions of the crane and trolley, is under the control of a single operator. The carriage is built with a large open platform for storing a load of plates, etc., while the crane is at the upper end of the ways. When the load is aboard, the crane is moved down the trestle and the trolley delivers each piece at its proper place. Heavy loads are picked up by the trolley and carried directly to place. Each crane is equipped with a counterweight running on a track above the hoisting trolley and connected by cables so that it automatically keeps a position corresponding to the trolley on the opposite arm. For



PLAN OF ONE OF THE CANTILEVER CRANES AT THE SHIPYARD OF WILLIAM CRAMP & SONS' SHIP AND ENGINE BUILDING CO.



ELEVATION OF ONE OF THE CANTILEVER CRANES BUILT BY THE BROWN HOISTING AND CONVEYING MACHINE CO.

carrying extra heavy loads out as far as one half the length of the arm, the counterweight may be placed at double the distance on the other side. The sizes and capacities of the three cranes already built, and the fourth which is proposed, are given in the accompanying table.

No. 2 crane is at the southwest, No. 1 is in the middle and No. 3 is to the northeast. It is proposed to locate No. 4 between Nos. 1 and 3.

	Nos. 1 and 2.	No. 3.	No. 4.
Length of trestle	547 ft. 0 in.	664 ft. 0 in.	582 ft. 0 in.
Height under crane	92 ft. 6 in.	95 ft. 0 in.	85 ft. 0 in.
Overall length of crane	200 ft. 10 in.	168 ft. 10 in.	143 ft. 10 in
Greatest beam of ship on ways	76 ft. 0 in.	66 ft. 0 in.	54 ft. 0 in.
Gage of track on trestle	20 ft. 0 in.	14 ft. 0 in.	14 ft. 0 in.
Distance of maximum load from center line of trestle	60 ft. 0 in.	46 ft. 0 in.	39 ft. 6 in.
Maximum load	30,000 lb.	20,000 lb.	20,000 lb.
Load carried at extreme end of crane	9,000 lb.	6,000 lb.	8,000 lb.

The speeds of the cranes are the same, and as follows:

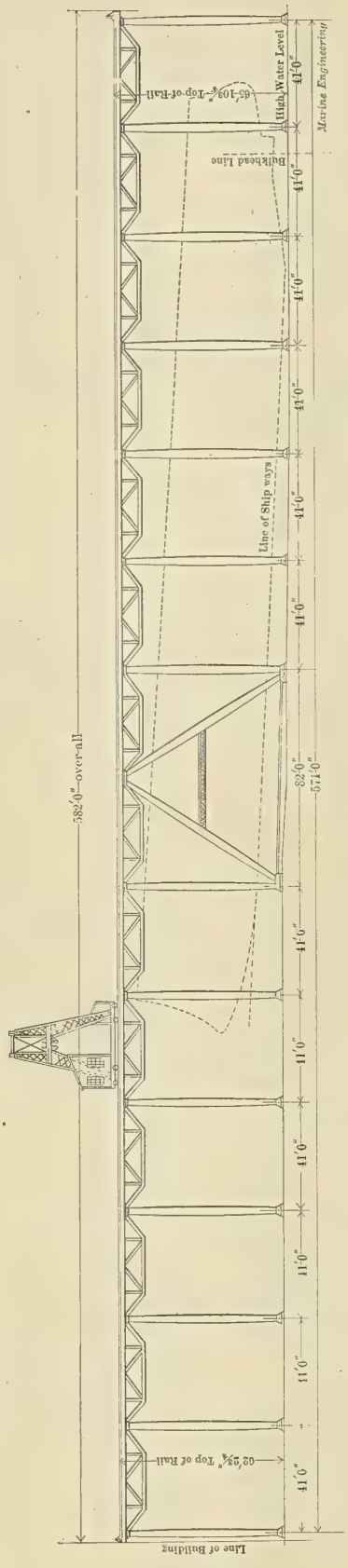
Hoisting full load, 125 ft. per minute.

Hoisting one-third load, 350 ft. per minute.

Hoisting 1,000 lb., 700 feet per minute.

Trolley across cantilever, 400 to 800 ft. per minute, according to load.

Entire crane along trestle, 400 to 700 ft. per minute, depending upon load and wind pressure. The minimum of 400 ft. per minute is with full load and against a wind pressure of 30 miles per hour.



ELEVATION OF THE CANTILEVER CRANE AND TRESTLE BUILT BY THE BROWN HOISTING AND CONVEYING MACHINE CO.

Belleville vs. Scotch Boilers.

The first series of comparative trials of the British cruisers *Hyacinth* and *Minerva* for information of the recently appointed Boiler Committee have been ended The two ships are identical, except in the boiler equipment. The *Hyacinth* has eighteen Belleville boilers, with 17,000 sq. ft. of boiler heating surface, and 7,000 sq. ft. of economizer heating surface, making a total of 24,000 sq. ft. The *Minerva* has eight cylindrical boilers, with 19,200 sq. ft. of heating surface. The steam pressure in the boilers of the *Hyacinth* is 300 lb., against 150 lb. in the *Minerva*, and the weight of the boilers with water is 280 tons in the former ship and 340 tons in the latter.

The trials were carried out under as nearly similar conditions as was possible. The *Minerva* was the first to be tested, and on a twenty-four hours' run at 3,000 I. H. P. she burned 2.2 lb. of coal per unit of power per hour for all purposes, while on a corresponding trial the *Hyacinth* consumed 2 lb. The evaporation of water per pound of coal in the *Hyacinth* was 9.7 lb. and in the *Minerva* 8.7 lb. The speed of each ship was 12 knots. At the twenty-four hours' trial at 5,000 I. H. P. the coal consumption in the *Minerva* was 1.74 lb. and in the *Hyacinth* 1.84 lb., and while the evaporation of water per pound of coal in the *Minerva* was 8.9 lb. in the *Hyacinth* it was 9.5 lb. Here again both ships gave the same speed—16 knots. On her eight hours' trial at full power, or 8,000 I. H. P., the *Minerva's* coal consumption was 2.4 lb. per I. H. P. per hour, while on an eight hours' trial at 10,000 I. H. P. the coal consumption of the *Hyacinth* was 2.1 lb., the speeds being

respectively 18 and 20 knots. The water evaporated per pound of coal in the *Minerva* was 8.1 lb. and in the *Hyacinth* 8.8 lb. The *Hyacinth* made a fourth run at 8,000 I. H. P. for the purpose of comparison, and the coal consumption was 1.8 lb per I. H. P., and the water evaporated per pound of coal was 10 lb. The speed recorded by patent log was 18 1-2 knots.

At each run boilers and machinery worked smoothly and gave no trouble of any kind. So far as the trials have gone they have shown a superior economy in the Belleville boilers of the *Hyacinth*, with a compensating extravagance on the part of the engines of that ship. That is to say, each pound of coal burned in the *Hyacinth* evaporated more water than the same quantity burned in the *Minerva*, but the *Hyacinth's* engines required the extra steam to produce the same power. The coal consumption at the different trials varied, and the result cannot be regarded as conclusive; but the *Hyacinth* has, at any rate, shown an advantage in speed.

Further competitive trials are to be made, the most complete any ships have yet been subjected to. The two cruisers are to empty their bunkers and coal from the same sample. They are then to start at a 16-knot speed for Gibraltar, but they will not put in at that port until their bunkers are empty. They will then coal again and race back to Portsmouth.

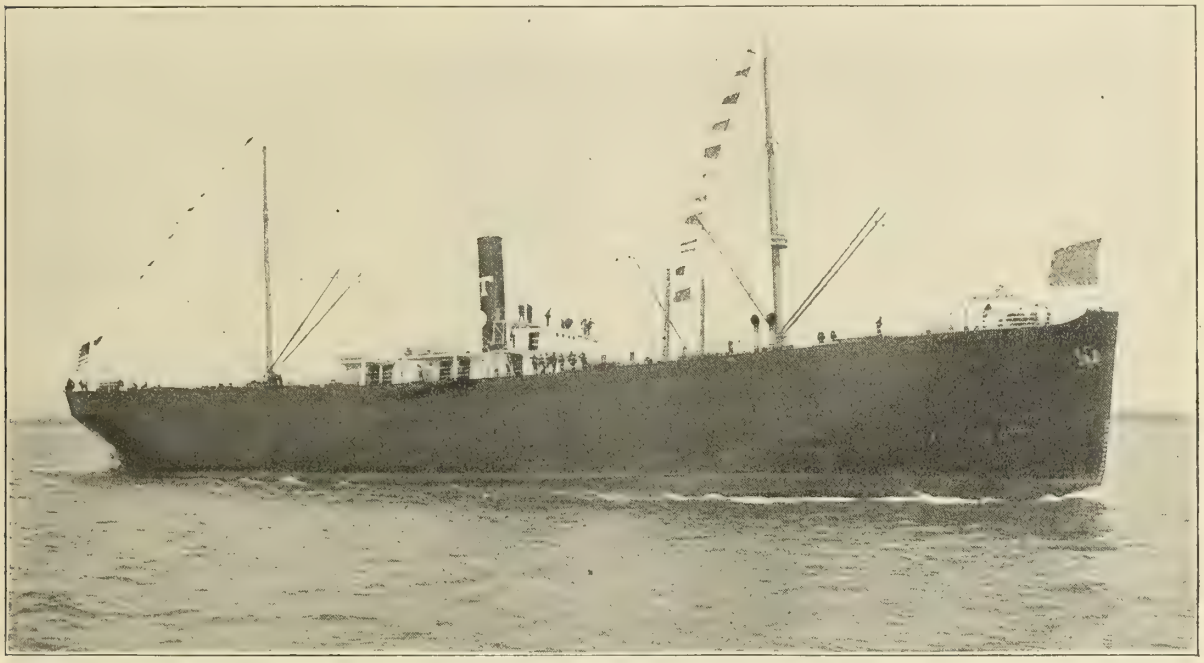
Steamship Lyra.

This vessel, which has recently been constructed by the Marine Department of the Maryland Steel Co., at Sparrows Point, Md., for the Boston Tow Boat Company, is similar to the S.S. *Pleiades* and *Hyades*, a full description of which was given in MARINE ENGINEERING for August last. In the *Lyra* certain changes and improvements have been made, a brief mention of which may be of interest as supplementing the descriptions of the two earlier boats.

The chief dimensions are as follows:

Length over all	350 ft.
Length between perpendiculars	330 ft. 6 in.
Beam molded	47 ft.
Depth molded, to main deck	28 ft.
Depth molded, to shelter deck	35 ft. 6 in.
Depth of water bottom	3 ft. 4 in.
Water ballast capacity	1,100 tons
Coal bunker capacity	650 tons
Deadweight capacity	6,300 tons
Cargo capacity	315,000 cu. ft.
Draft, loaded	24 ft. 3 in.

A complete shelter deck has been fitted on the *Lyra*, whereas the earlier vessels had a bridge, poop and forecastle. The hull is of steel, with water bottom extending from forward to after collision bulkhead. There are six watertight bulkheads and one non watertight. Three complete steel decks are fitted. On the shelter deck amidships is a deck house for officers and engineers. The crew's quarters are on the main deck forward.



STEAMSHIP LYRA BUILT FOR THE BOSTON TOW BOAT CO. BY THE MARYLAND STEEL CO.

There are seven hatches which are served by five 8 in. by 8 in. "Hyde" steam winches. The windlass is a No. 9 "Hyde" machine with 10 in. by 10 in. engine on deck. The steam steering gear is a 7 in. by 7 in. "Williamson."

The machinery consists of a single screw triple expansion engine with cylinders 21, 35 and 56 in. dia. by 42 in. stroke. There are two single ended Scotch boilers 14 ft. 6 in. dia. by 10 ft. 9 in. length, carrying 175 lb. steam pressure.

All the pumps, except the air pump, are of the independent duplex Worthington type.

The *Lyra* was launched April 30 and 15 days later was given a dock trial. She left the works of the builders on June 6, and after making a short trial run proceeded directly to Newport News, where she loaded with coal for Boston.

MARINE ENGINEERING

PUBLISHED MONTHLY

BY

MARINE ENGINEERING,

INCORPORATED,

309 Broadway, New York.

H. L. ALDRICH,
Treasurer and General Manager.

PROF. W. F. DURAND,
Advisory Editor.

F. D. HERBERT,
Associate Editor.

Branch Offices.

Philadelphia, Pa., Mach'y Dept., The Bourse, S. W. ANNESS.
Detroit, Mich., Hodges Building, L. L. CLINE.
Boston, Mass., 170 Summer St., S. I. CARPENTER.

TERMS OF SUBSCRIPTION.

	Per Year.	Per Copy.
United States, Canada, and Mexico.....	$2.00	20 cents.
Other countries in Postal Union.....	2.50	25 cents.

Entered at New York Post Office as second class matter.

Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

Will the author of the article on "Steam Jackets" please send his name and address to this office?

THE question of the gain in economy for triple expansion engines over compound is one which in the minds of some is not yet settled, especially for what may be termed knock about service. We would invite the special attention of all who are interested in this question to the article on another page by First Assistant Engineer C. A. McAllister, of the United States Revenue Cutter Service. It would be difficult to find a set of conditions under which a fairer comparison could be made of the relative economy of two engines than those described.

It would be difficult furthermore to find a set of conditions under which, according to general estimate, the compound engine should be able to make a better showing relative to the triple. If with the type of service described the compound is not better than the triple, it can hardly be expected to show such a result under any other set of conditions to be found in marine service. The only essential difference in the conditions is in the displacement of the two boats, one of which is about six tons larger than the other. This difference is, however, in favor of the compound engine and the saving shown by the triple expansion engine is therefore all the more marked.

The time involved in the comparison is also of sufficient length to include all minor fluctuations and the final result must be accepted as a fair comparison between the two types of engines, at least for the particular service on which they are used. The difference of 68 tons per year means an increase in expenditure for the compound of 18 per cent as compared with the triple. The story is told with sufficient emphasis by the figures given and little additional comment is needed.

There is but one further point. It would have been doubly interesting had there been a third boat similar to these and doing like service, with the same boilers and with a compound engine having the same ratio of total expansion as in the triple expansion engine of the *Hudson*. Compound engines with these high rates of expansion have made a most excellent showing, and this comparison would serve to show whether under the conditions described the gain of the triple over the ordinary compound is to be ascribed to the greater range of expansion, or to the fact that the process is broken up into three steps instead of two.

In the meantime, however, the triple expansion engine is firmly installed as a standard type for marine practice, not only on account of its superior economy, but also by reason of greater smoothness of running and suitability for balancing than is found in the two crank compound. Even if the former reason did not exist the latter would furnish quite sufficient reason for adopting it as a standard type rather than the compound with two cranks and a less perfect balance of moving parts.

THE question of the superiority of the big cup defenders seems to be still in considerable uncertainty. *Constitution* at the present writing seems to have made the best showing on the whole although *Columbia* has shown herself better under certain conditions, and *Independence* in heavy winds is by no means out of the race. From the scientific point of view the interesting feature in the history of the defender yachts from year to year has been the regularity with which the competent designer seems each year to be able to improve on the results of the

preceding year. Progress in engineering depends always upon experience and upon the utilization of the facts of observation, and in no field has this been more plainly marked than in naval architecture and marine engineering. In particular the qualities needed to make the most successful sailing yacht are so obscure and so dependent on imperfectly understood conditions affecting resistance of bodies to motion in a liquid, that any theoretical discussion of the question is quite out of the question and only by experience can we hope for progress. Something more than mere experience, however, is required. Of equal importance is the skill with which this experience should be applied, and it is here that the advances during the past few years have been made. Given the experience of each year, it has seemed possible to improve in some degree upon the past and to turn out a series of successively better and better yachts, at least for the conditions prevailing on the cup trial races. If we believe that this progress is not to be interrupted this year, then we may pin our faith on *Constitution* as a better boat than *Columbia,* especially when her sails and rigging shall be as well fitted and her individuality as well known.

In the meantime the trials between the two challengers on the other side of the water, so far as can be determined from the published reports, have shown the boats not unevenly matched, but at the same time give evidence fairly well pronounced in favor of the newer boat. At the same time it would need an intimate knowledge of many circumstances not known on this side of the Atlantic to make any estimate of the real difference between the two.

On the whole the races this year promise to be of exceptional interest not only on account of the event itself, but also as furnishing evidence as to whether further progress in the development of these yachts is likely, or whether given the length and all other limiting conditions, we are approaching a limit on this particular line. It would not be surprising were the latter the case, and, in fact, having in view the development of the past few years, it is hard to see how it can go on without some change in the conditions. It would seem fair to assume that with the study which has been put on the problem the possibilities of the present situation have been pretty well exhausted, and that no great advance is possible without some change in the limiting conditions.

THE recent collision between the ferryboats *Mauch Chunk* and *Northfield* brings again to our attention the wretchedly inadequate provision for saving life which is found on such boats or perhaps more deeply, the light estimation placed on the value of human life by corporations in whose hands its safety is placed. We are not making any attack on corporations as such, but it is a fact of human nature that familiarity with danger is likely to breed contempt, and a long period of freedom from accident is liable to obscure its possibility from consideration. All this means simply that with human nature as it is, it is too much to expect that any company or corporation of public carriers shall unstimulated provide and maintain all the provision needful for the proper safeguarding of the lives placed in its care. The obvious solution is to place in the hands of an uninterested body the inspection and supervision of all means relating to the safety of human life and to empower such body with the authority needful to see that its provisions are carried out, and to make it their duty to secure such fulfillment. This is, of course, actually done, and we have the well known inspection service with its corps of inspectors authorized by Congress and with its code of requirements for safeguarding life. The trouble is not with the fundamental law or with the question of authority, but with the way in which it is carried out.

We shall not here undertake to say to what extent the rules and regulations are adequate, or to what extent there is laxity in applying them to individual cases. We believe, however, that in both directions there is room for some improvement. The point of the whole matter is that with human life valued at its proper standard and with such provision for its care as the situation in our harbor demands, it is not probable that the *Northfield* would have been allowed to run in the condition in which later examination has shown her to be, and especially with an inadequate provision of life preservers on board. That the loss of life was not more serious is due not so much to adequate provision for such an accident, but rather to the nearness to the slip when it occurred, and to the presence of other boats, which took off the passengers before the *Northfield* sank, or picked them up from the water afterwards. If the collision had occurred in the more open waters of the bay the tale of the lost would undoubtedly have been a far different matter.

THE CONTEST FOR THE PRIZES.

All articles intended for competition for the two prizes of $15 and $10 each, mentioned in our advertising pages, must be sent in promptly, as the contest will close on December 31.

All articles published will be paid for at the regular rates. The best and the next best will draw the prizes in addition.

Repairing a Propeller Shaft.

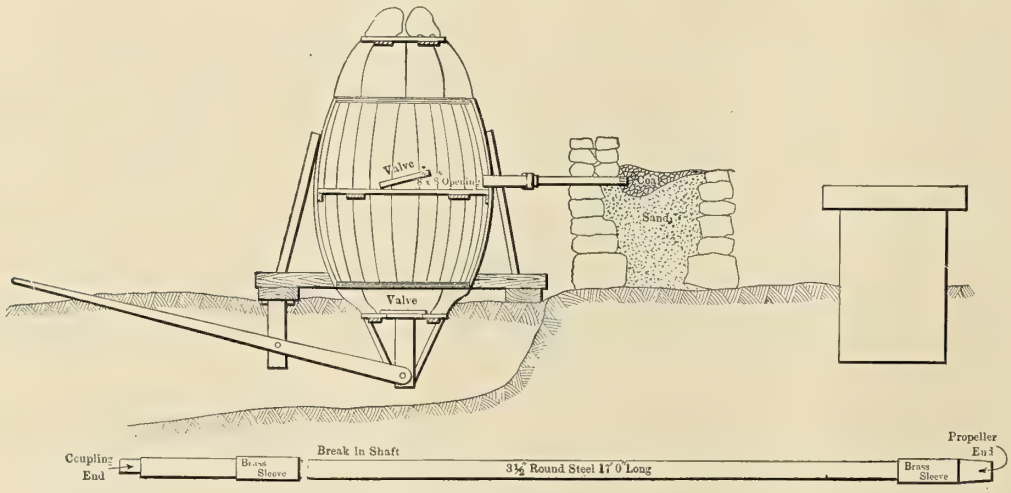
The writer left the port of St. John, N. B., on Aug. 20, 1894, in the steamer *Greenwood*, 10.7 register tons, bound for the Island of St. Kitts, British West Indies. When 250 miles from Nassau and near Long Island, Bahamas, our propeller shaft broke in the stern tube. As we had neither masts nor sails we were perfectly helpless. As this was the hurricane season our first consideration was to reach a place of safety, which we found at Great Harbor on Long Island. The second consideration was where to go for repairs. New York could be reached in the shortest time by taking sail boat to Nassau and from there by steamer, but as it would require at least three months to make this trip and return, I looked about the island for means of making our own repairs.

In the meantime we were at work removing the shaft. This we accomplished by tipping the steamer. The usual draught was 6 ft. 3 in. aft and 4 ft. 6 in. forward. By rigging outriggers over the stem and planking them over we made a platform on which was piled all our fuel in bags, thereby changing the draught to 4 ft. 6 in. aft and 6 ft. 3 in. forward. This angle I found to be about the slope of the shore, and, after getting some heavy non-floatable blocks of wood placed at intervals and partially buried in the sand, we drew the steamer up on them, and with shores to steady and falls leading to trees on shore, we pulled her up sufficiently to get the shaft hole out of water. The drawing of the shaft was now simple, and after one and one-half days' labor we had the boat up and shaft out on shore.

In the meantime I had been thinking pretty strongly how to rig up to weld it, and, after careful consideration, concluded if I could get a good-sized cask I could make a bellows out of it, and the forge would be a simple matter.

You will allow me to digress for a few lines. When I started to serve my apprenticeship at the engineering trade I was compelled, as well as all other boys at our shop, to serve a part of the time in the blacksmith shops, and our success in getting into the machine shop depended on how quickly we could learn the blacksmith's trade. This is not the method carried out in these days, but I have many times blessed the old system, as my knowledge of smithing has brought me out of many difficulties; and as I would now say to all young men who purpose making their living as marine engineers: "Do not despise the blacksmith trade. Learn what you can of it; it costs nothing to carry, and you cannot tell when your ability may be of use to you or possibly to others who are not up in it."

To find a cask on this island was difficult, but after many inquiries I found a deck water cask out of some vessel which had come ashore. It was then in use at the rector's house to hold rain water, having been taken there and set up and a small shed built around it. The accompanying cut shows the construction of the bellows and forge, and also the broken shaft:



For an anvil we had a piece of ballast iron which I picked up on the shore; also I was fortunate to get an old sledge from one of the islanders, which he had gotten from the wreck. For coal some of the boat's fuel was used, which did very well, and gave very clean heats.

The shaft requiring to be the same length when welded as originally, I had to look for a piece to put in it, and, fortunately, found a piece of scrap iron at the wrecked vessel. It was 3 1-2 in. by 5-8 in., and after doubling thickness on thickness I had sufficient size and welded it up solid. This I welded to the long piece of shaft, using the V form of weld and then welded on the short end of the shaft. When finished and cooled the shaft was 1-8 in. shorter than the original length. Knowing that I had a trifle latitude I did not draw it.

My method of straightening was on two V blocks fastened on the lower mast of the wrecked vessel, which was handy to where we were working. By putting the

shaft in them while hot we succeeded in getting it perfectly straight and true on the parts which had been turned before, and as the parts, where the welds were made were large, we reduced them with hammer and chisel, keeping those parts true while so doing. I next fitted on and pinned the brass sleeve and now had the shaft ready for shipping in the boat.

On taking the shaft out of the steamer we had to plug the hole and put her off again in deep water for safety, so now being ready to put the shaft in we repeated the operation on the steamer and replaced shaft and propeller and were once more ready for sea.

The total time occupied on the job was twelve days from time of shaft breaking until we were again on our way to St. Thomas, which place we reached, after 5 1-2 days' steaming.

After completing our work the cask was reconstructed and given a good coat of paint and returned to its original use at the rectory.

On reaching St. Thomas we had the steamer taken out on haul-up slip and cleaned. The shaft was removed and examined and found all right. The steamer was run to St. Kitts, where she was used between St. Kitts and Nevis, carrying mail and passengers. The same shaft was not removed, but continued in use up to the time the boat was lost in the hurricane of October, 1899. GEO. H. WARING.

Shipping the Troops Home.

Editor of MARINE ENGINEERING:

It may interest your readers to note how the volunteers were transported home after two years' service in the Philippines.

DECK SCENE.

We left Manila in March of this year and arrived in San Francisco after 24 days' run, during which we had a stoppage of four days at Nagasaki, Japan, for coal. It was a good voyage and every soldier enjoyed it. There was very little sickness. We had three-quarters of the upper deck, as shown in the views, and the officers had the other quarter of the deck.

We struck a storm one day and it lasted far into the night. This view shows how the deck was deserted. The waves did not go over the deck, but they came near doing so. It was difficult to get a hold.

We soldiers had our washing to do and little jobs to attend to and these things were done in the bow. We had good sleeping quarters below and plenty of room in the mess hall for one company to eat at one time.

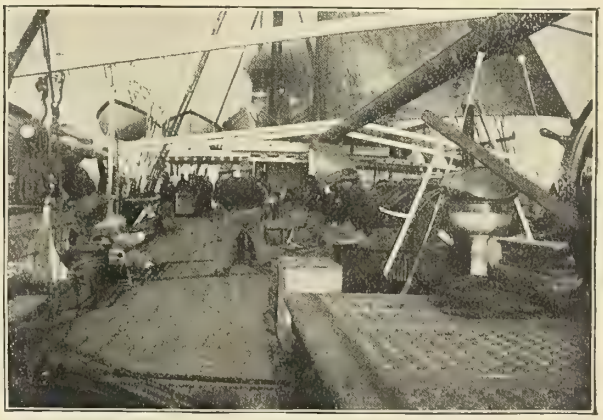
DURING A STORM.

The mess hall was kept in service all the time to accommodate all of the companies in the regiment.

We sighted passing craft once in a while and this

IN THE BOW.

view shows the men looking off to the sea at a steamer passing. Taking it all in all I enjoyed the trip both to and from the Philippines, and the next time Uncle Sam



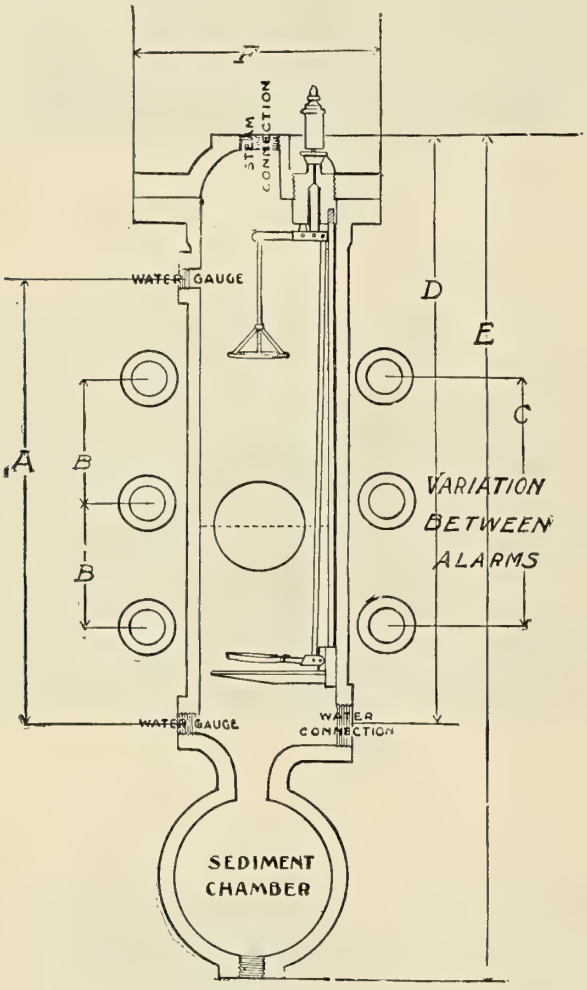
WATCHING A PASSING STEAMER.

wants my services in a foreign land he can have them if he gives me a good ocean voyage like the last, in which I saw the world. "EX-VOLUNTEER."

ENGINEERING SPECIALTIES.

Improved Safety Water Column.

The economic value of safety water columns is daily becoming better recognized, not only because they protect life and property, but because they insure constant watchfulness and care on the part of the attendants, thereby reducing the amount of fuel consumed, obviating repairs and prolonging the life of the boilers. In the Wright column here illustrated several improvements have been introduced. All the working parts

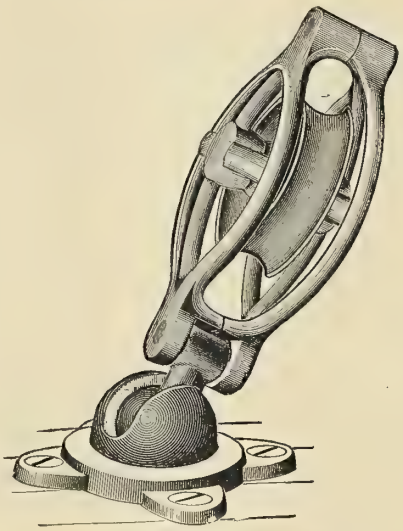


WRIGHT SAFETY WATER COLUMN.

are attached to the cap, the valves are placed vertically instead of horizontally, one valve is used instead of two, the float is a seamless sphere and therefore the possibility of its collapsing or filling with water is reduced to a minimum. The alarm whistle is blown at both high and low water by the floating ball striking the upper or lower disks, which are connected to the whistle valve. The water glass is connected on one side at top and bottom, and the gage cocks on the other side. Connections with the boiler are made at top and bottom and the sediment chamber is fitted with a blow off. These columns in various sizes are made by the Wright Manufacturing Company, Detroit, Mich.

Bronze Yacht Blocks.

The accompanying cut shows one form of the oval edge star bronze yacht block recently put on the market by the Boston & Lockport Block Co., Boston, Mass. The block is unusually light and strong; the metal is made from a special formula and has been tested at the Watertown Arsenal with satisfactory results. They are made up with all the connections which are used or called for in wooden blocks. The shells are oval on the edges and have rounded sides so as to prevent the chafing of either the ropes, spars or deck. One new feature is that on the shackle blocks the shackles can be made to stand either front or side without sending

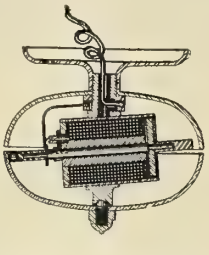


SWIVEL BRONZE YACHT BLOCK.

the block to the factory to have any changes made. The swivel sheet leader here illustrated is entirely new and will work in any position and not strike the deck.

Thornton's "Wake 'Em Up" Bell.

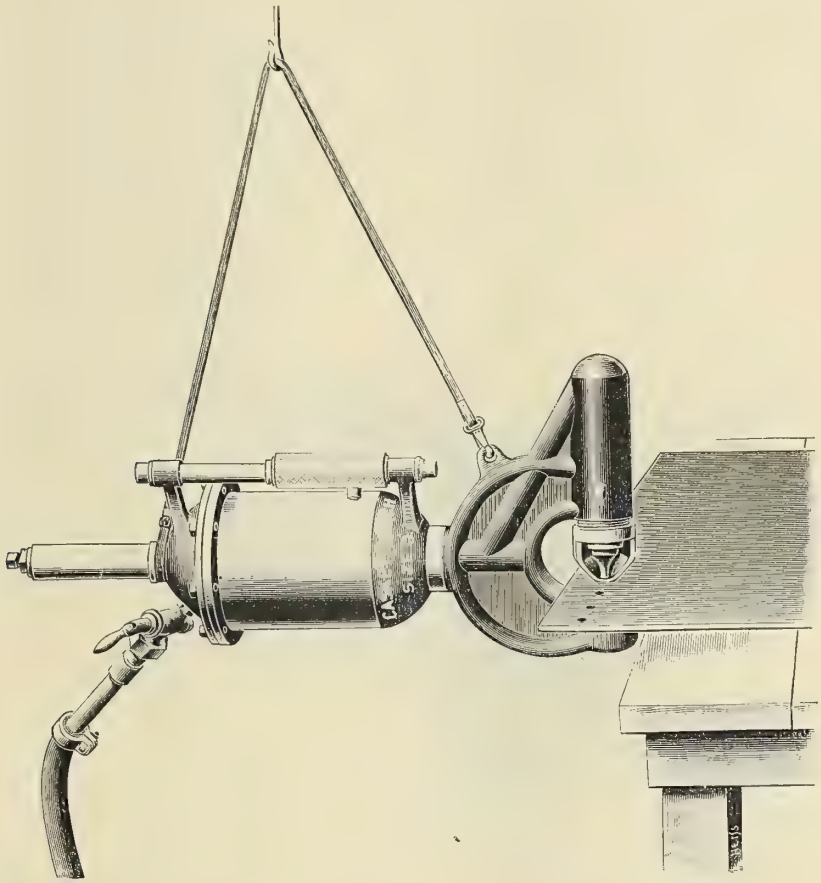
The usual line followed by manufacturers in making electric bells has been on a single stroke basis. There is now on the market a dry battery bell for automobiles



SECTION OF ELECTRIC BELL.

or vessels, steam launches and pleasure craft, deviating from the usual line, inasmuch as the mechanism is entirely concealed by two nickel-plated highly polished gongs made of the best bell metal. They are resonant in sound, and, when operated, give forth a chime due to striking the upper and lower gongs alternately. The

armature and magnet are moisture proof and very durable. Each bell is throughly tested, inspected and permanently adjusted before leaving the factory. The make and break portion is of special interest, as the tips at point of contact are of platinum, insuring longevity of the mechanism and preventing burning and insulating of surfaces, as is the case with cheaper bells. In appearance the "Wake 'Em Up" Electric Bell is neat and beautiful. Further information can be obtained at the office of G. C. Thornton, 3 East Fourteenth street, New York city, where also the bells may be seen.



THE CASKEY PORTABLE PNEUMATIC PUNCH.

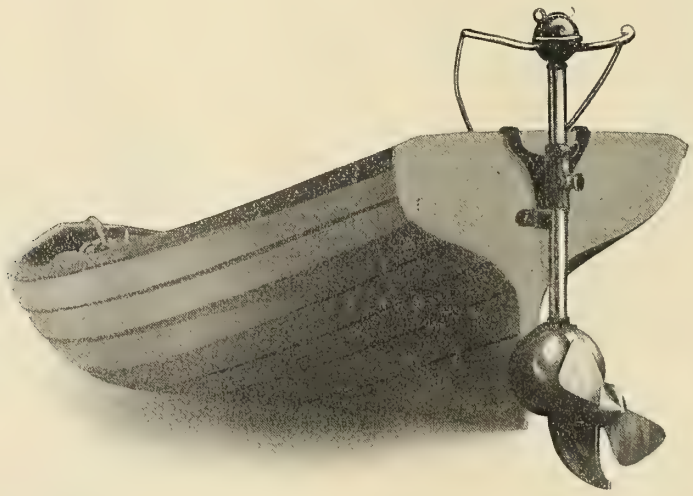
Portable Pneumatic Punch.

A new portable punch built in four sizes and adapted to work on plates up to three-quarters of an inch thick has recently been placed on the market. The tool was designed by a machine shop superintendent and given many months of trial. A number of the punches are now in successful operation in various shipyards, carshops, etc. It is claimed that by the use of this punch one man can do the same amount of work as may be done by a gang of men with the ordinary power punch. The pneumatic tool has also other advantages, including accuracy of work, as it is easier to move it to the exact mark than to swing the plate in the jaws of the old style of punch. There is also a saving of space, and the feature of portability adapts it for work on board ship, for manhole cutting on boilers, for stacks, tanks, etc., and for work in the field. In construction the tool is quite simple, and this gives it great durability. The chief distinctive feature is a hollow piston containing oil, within a prolongation of which a stationary tube is adapted to telescope—the oil being thereby forced into and through said tube and thence upon the plunger, where it exerts accumulated pressure. The air which drives the piston during the stroke is utilized to drive it back for another, being finally expelled through the exhaust during the next succeeding stroke. This, as will be apparent, effects an important saving in the amount of air used. The punch was invented by S. S. Caskey, and is built by F. F. Slocum & Co., Wilmington, Del., from whom any further details may be obtained.

Submerged Electric Motor.

This new and remarkable invention has been brought to a high degree of perfection, and is especially adapted for use on row boats, fishing, hunting and pleasure boats of all kinds, launches, yacht tenders and as auxiliary power for sailing craft. The apparatus is complete and portable, in three parts, the whole weighing but 135 lb. It occupies the place of the rudder, and can be placed in position on any boat or exchanged from one to another in five minutes. The motor itself is under water, while the storage batteries are in such compact form that they may be placed out of the way

under the seats of any ordinary row boat. The motor not only propels the boat, but steers it as well, the boat answering to it more readily than to a rudder. It is so extremely simple in construction that anyone can operate it, and it is not liable to get out of order. The motor drives the boat forward or backward, and can be regulated to run at any speed up to four miles per hour, using two boxes of four cells, and will run from 20 to 30 miles on one charge. More cells may be used if desired, and a speed of six miles per hour attained. The lubrication of all working parts is perfect, thus insuring great durability. The yachtsman or fisherman who has this motor on his sail boat is independent of the wind. The accumulators have large surfaces of active material, and are capable of returning a large per cent. of the energy, which, with the high efficiency of the motor, gives to boats equipped with this apparatus a large radius of travel. Any further information will be given by writing to the makers, the Submerged Electric Motor Co., Menomonee, Wis.

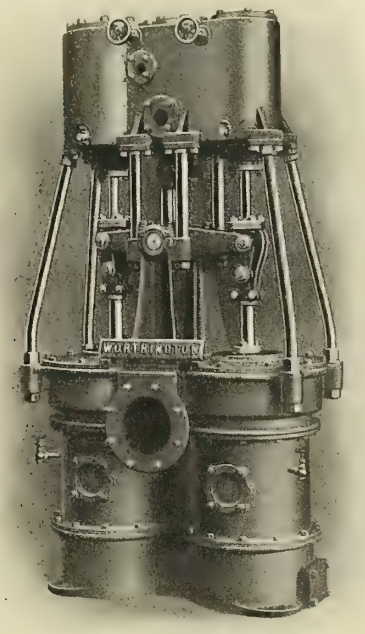


THE SUBMERGED ELECTRIC MOTOR.

Worthington Beam Air Pump and Condenser.

The demand for an air pump and jet condenser to occupy the least possible floor space and still have all its moving parts easily accessible has led to the design and construction of the Worthington vertical beam air pump. The cut following shows the pump with the condensing chamber removed. This chamber is usually placed at the rear and connects directly with the channel plate at the bottom of the pump. The opening in front is for discharge water. This pump is of great simplicity and strength. Each side of the pump is single acting, the buckets being of the form used for many years in attached air pumps for marine service. The two sides are connected together by a beam and links attached to the crossheads. As one side comes down and does but practically little work the other side makes an up stroke and does full work in evacuating the condenser to which the suction is attached. The steam cylinders are cross compounded. The high pressure cylinder on one side exhausts through the valve chest to the low pressure on the other side of the pump. This is a very simple arrangement and the benefit of compounding is obtained without complication, there being practically no more parts than with simple steam cylinders, each taking live steam, and with no attempt to use the steam expansively. The valve motion is extremely simple and durable. Aside from the outside rod, which moves the small pilot valve, there is only one moving part, which consists of two piston valves mounted upon and rigidly secured to a steel rod, both valves moving together and giving steam alternately to one side and the other, as the position of the buckets requires. The steam and water cylinders are held rigidly together by four steel tie rods, which, while giving great lightness to the machine, permits of accessibility to all moving parts. Another point worthy of note is that the beam is supported and held in place by a cast iron bracket, which is securely bolted to the water cylinders. Four short steel tie rods extend from the steam cylinders to the sides of the bracket and add further to the rigidity of the machine; the object of this arrangement is to cause the center bracket to take all the thrust resulting from the moving beam and consequently relieve other parts of the machine. The adoption of this form of condenser materially reduces the total suction lift without necessitating changes or alterations in the plant. Another advantage resulting from this particular design is that when these air pumps are used in connection with surface condensers, as is frequently the case, the condensers can be readily located with great economy in space, owing to the fact that the suction chamber of the air pump is so low that the condensers can be placed very close to the floor line. At the same time the condenser is sufficiently high to allow the condensed water to flow into the pump. On the other hand it is frequently desired to place the condensing apparatus in a pit, and the Worthington vertical beam condenser is particularly well adapted to such locations, since the throttle, injection and regulating valves are all placed above, and the condenser can be

conveniently operated from the engine room floor. The most satisfactory and gratifying results have been obtained with this form of condenser, both on marine and stationary service. These machines are installed in a large number of the battleships of the United States Navy, in connection with both the main engine and the auxiliary machinery. Their light weights, simplicity and compactness make them especially adapted to naval and yacht service.



LIGHTWEIGHT BEAM AIR PUMP.

Evaporators for Marine Service.

Fresh water for boiler feed has under modern conditions come to be considered as nothing less than a necessity. Some provision is, therefore, needful to replace the losses which occur at many places, such as defective joints in the boilers or pipes, leaky stuffing boxes, etc. A fair average requirement for a plant, in ordinary good condition, is about three tons of auxiliary feed water per twenty-four hours for each 1,000 I. H. P. of the machinery.

There are two ways in which the fresh water needed can be supplied—the storage of a supply in special tanks or double bottoms, and distillation from sea water. The former has the objection of increasing the displacement of the vessel, and is only applicable, as a rule, in vessels making regular trips between large ports. The latter, when properly arranged, makes ample provision as long as there is coal to raise steam. It has, further, the great advantage of providing pure water for drinking purposes, a specially valuable feature of naval vessels, yachts, etc., which go to all parts of the world.

The distillation of fresh water from sea water necessarily involves the formation of scale, and the evaporator was invented to provide for the supply of heat from steam, instead of hot gases (as in a boiler), so that even when neglected there should be no danger of injury to any part of the apparatus.

The working steam is taken from the boiler or one of the receivers of a multiple expansion engine, and after condensation is returned to the feed tank and then pumped into the boiler. The steam generated from the salt water may be sent to the low pressure receiver or to the condenser if intended to make up losses; or if intended for drinking water, it is sent to the distiller (which is a small special condenser) and when condensed runs by gravity, or is pumped to the fresh water tanks.

The above features apply to evaporators generally. The accompanying illustration shows Quiggins patent evaporator manufactured by the James Reilly Repair and Supply Co., and for which the following special claims are made.

1st. *Lightness.*—Due to the fact that there are no large steam chests or tubes of large diameter.

2d. *Compactness.*—Due to the application of the heating surface in the shape of special coils and their connection to circular manifolds.

3d. *Adaptability to Space.*—Owing to the nature of the heating surface, the evaporator can be designed to suit almost any requirements as to space. If there is little floor space, but plenty of head room, it can be made of small diameter and greater height. Where the conditions are reversed, the diameter is increased and height reduced.

4th. *No Extra Room Required for Scaling.*—If there is room enough in front of the manholes of the evaporator for a man to attend to it when working, no extra room is needed to remove the coils for scaling.

5th. *Facility for Scaling.*—For scaling it is rarely necessary to remove the tubes and if it is, the coils are light and easily removed and scaled.

6th. *Capacity May Be Increased Without Changing Space.*—The heating coils, as fitted, occupy only a portion of the space within the shell. If it is found at a future time that a greater output is needed, new manifolds for a larger number of coils can be supplied, so as to give at least 25 per cent increase in output, without any other change.

The chief structural features of this type of evaporator are as follows:

Shell.—The evaporator consists of a vertical steel shell, the body and heads of which are made of 60,000 lb. marine steel, and to stand a pressure in accordance with the U. S. Steamboat Inspectors and the U. S. Navy Department requirements.

Riveted to the shell are two substantial manhole frames and plates, so located as to afford ready access to the interior for cleaning purposes, or for disconnecting the coils. The shell being of the vertical type, and having an abundance of vapor space in the upper portion, priming is avoided.

Fitted to the shell is a suitable plate of rolled zinc, of proper area, for taking up the galvanic action.

Manifolds.—Securely bolted to the inside of the shell, in the lower portion, are two annular composition manifolds, of proper thickness to withstand the usual boiler pressure. These manifolds have projections cast on, which are carefully bored out, threaded and ground, for engaging the coils.

Coils.—Connected to these manifolds, in a vertical position, are the heating coils. These are made of seamless drawn copper tubing, are spiral shaped and thoroughly tinned. The tubes have a crescent-shaped cross section with internal area diminishing gradually from top to bottom. They are consequently very elastic in every direction and the joints are unaffected by expansion and contraction. They have been found to withstand a pressure of 1,500 lb. per square inch before rupture.

Brazed to the ends of these coils, are composition ground joint unions, to fit the projections on the manifolds. These joints are made without washers, and are perfectly steamtight.

The coils are all made to a gage, are interchangeable, and can be disconnected in a few minutes when required. Owing to their inherent elasticity it is impossible for them to leak, being unaffected by irregular expansion and contraction. If, by any mishap, the feed should be stopped, the coils would not be damaged by becoming exposed, and no harmful results to the evaporator can arise from inattention to the feed or from overheating the coils.

The operation of this evaporator is as follows:

The coils *B* in the lower part of the shell receive the steam from the main boilers, or from the I. P. receiver, through the upper manifold *C*.

Those coils are covered to a certain height by the sea water, which is fed into the shell by means of a small feed or donkey pump set to supply the amount of water required, and to maintain a uniform feed level of water in the evaporator. This pump takes its suction from the circulating discharge, thereby getting the benefit of the heat which has been given up by the steam in condensing.

The steam from the boiler, or from the I. P. receiver, in passing down through the coils gradually gives up its heat to the liquid surrounding them, and converts it into vapor. By the time the steam reaches the bottom manifold *E*, it has given up all its heat above the temperature due to the pressure carried in the shell, and has been condensed to water, and in this form is returned by the automatic trap to the boiler feed tank.

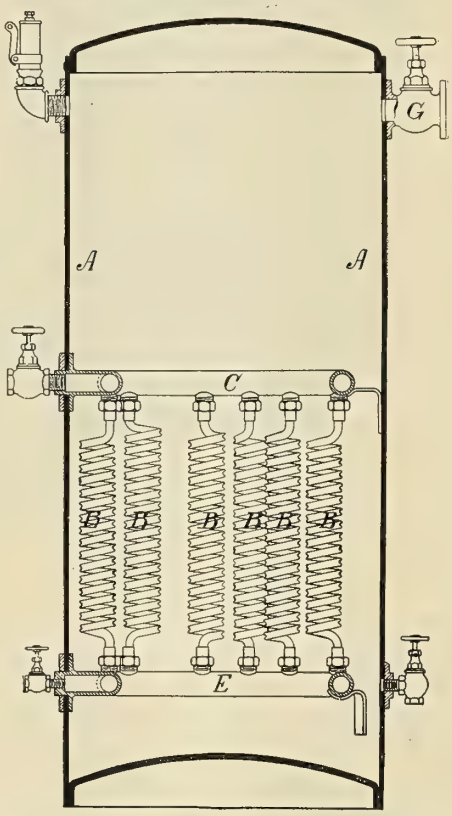
The vapor arising from the top of the liquid comes in contact with the upper part of the coils and is thoroughly dried, and any spray or priming that might rise through too violent ebullition, is thus prevented from passing over with the vapor through the pipe *G* to the receiving tank, condenser or L. P. receiver.

The constant evaporation which leaves all the solids behind necessarily causes the precipitation of scale on the heating surfaces, thus gradually reducing their efficiency. In this evaporator the nature of the heating surface insures the cracking off of most of the scale as fast as formed, owing to the expansion and contraction of the spiral coils, the tubing of which has a crescent cross section as shown. The scale accumulates in the bottom of the shell, and is readily taken out through the lower manhole. If any of the scale has hardened and still remains on the coils, it can easily be removed by blowing off the hot liquid and then turning on steam to the coils, thus causing a sudden expansion and breaking off of the scale, or it can also be easily removed by striking the coils gently with a stick or hammer handle.

The same form of apparatus is also used for distilling water for drinking purposes. For this purpose the most economical plan so far as the consumption of steam is concerned is to use the evaporator in triple effect. To this end three separate evaporators are used: Nos. 1, 2 and 3. The salt water to be evaporated is fed into the shell of each evaporator, and kept at the proper level by the feed pump.

Steam from the boilers at a pressure of say 100 lb. is introduced into the heating coils of No. 1 evaporator only. This steam, by boiling the salt water contained in the evaporator, will produce pure vapor at about 15 lb. pressure; this vapor being led into the heating coils of No. 2 will boil the salt water it contains and produce vapor at about 3 lb. pressure. This is led into the coils of No. 3, and will produce from the salt water surrounding the coils, vapor at a pressure of about 10 to 12 lb. below the atmosphere. It is therefore necessary to have a regular condenser fitted with an air pump to produce the necessary vacuum. The vapor from No. 3 is condensed in this condenser, and the drains from Nos. 2 and 3 are also passed through it to have their temperature properly reduced. The drain from the coils of No. 1 is returned

CROSS SECTION OF EVAPORATOR COIL



SECTIONAL VIEW OF QUIGGINS EVAPORATOR.

to the feed tank through feed heater for boiler feed. The results of using 100 lb. weight of steam at 100 lb. pressure in the heating coils of No. 1 are as follows:

Fresh water from the heating coils of No. 2, about 90 lb. weight.
Fresh water from the heating coils of No. 3, about 87 lb. weight.
Fresh water condensed from the vapor of No. 3, about 88 lb. weight.

Therefore, allowing for loss by blowing off, from the use of one pound of steam we obtain about 2 1-2 pounds of fresh water.

As the temperature of the drain water from No. 1 is considerably above 212°, it is sent with exhaust from pumps through a feed heater for raising the temperature of the salt water feed for the evaporators. The drain from Nos. 2 and 3 is sent to the condenser, so that the temperature of this water is the same as that of the condensed vapor from No. 3.

These plants can be arranged so as to work each evaporator singly, or in either double, or triple effect.

Following are the results of a series of tests made on these evaporators, arranged to work in either single, double or triple effect*:

There were three evaporators with vertical shells 24 in. in diameter, and 6 ft. 6 in. high.

A Quiggins condenser, with vertical shell 15 in. diameter by 42 in. high, filled with coils similar to those in evaporators, was used to condense the vapor from shell of last effect.

The evaporators were placed in the boiler room on a platform, about 6 ft. high, and set in line about 35 in. from center to center. They were covered, around shells, with one inch of hair felt.

The condenser was also located conveniently on the platform. This arrangement enabled the discharge water from the coils, condenser, etc., to flow by gravity to measuring tanks below the platform. The evaporators were so connected that either one, two or three could be used at the same time, to obtain either one, two or three evaporative effects, as desired.

For single effect, the steam entered coils of evaporator through a pressure-regulating valve, and the vapor, generated from water surrounding the coils, was conducted from top of shell, through a 1 1-2 in. pipe, to condenser.

For double effect, the steam entered coils of first effect as above, and the vapor generated in shell was conducted, through a 1 1-2 in. pipe and valve, to top of coils of second effect. The vapor from shell of second effect then passed through 1 1-2 in. pipe to condenser.

For triple effect the connections were the same as for double effect, except that the vapor from shell of second effect passed to top of coils of third effect, and the vapor from shell of this effect passed to condenser.

When operated in multiple effect, each evaporator acted as a condenser for the effect immediately preceding it; the regular condenser being used only for vapor from shell of last effect. The bottoms of shells of evaporators were connected together, in series, by means of 1 in. pipes and cocks.

The following tables give the chief features of six out of the ten tests made. The facts are given in such detail as to need no further explanation.

*Abstracted from the *Stevens' Institute Indicator* for April, 1901.

DATA OF TESTS OF SINGLE EFFECT.

Number of test	No. 1.	No 2.
Duration	2 hrs.	2 hrs.
Feed water from	City Mains	East River
Average lb. of steam used per hour	1,127	1,130
Average lb. of dist water per hour	933	969
Lb. of water evaporated per lb of steam	.83	.86
Average lb. of feed water per hour	933	1,096
Average lb of blow-off water per hour	0	127
Average lb. of condensing water per hour	19,072	19,712
Average temp of drip from coils	195° F.	197° F.
Average temp. of distilled water	98° F.	105° F.
Average temp. of feed water	65.8° F.	118° F.
Average temp. of blow-off water		177° F.
Average initial temp. of condensing water	70.5° F.	69.6° F.
Average final temp. of condensing water	117.2° F.	118° F.
Average temp. of atmosphere	91° F.	94° F.
Average steam press entering coils of evap.	77.8	77.8
Average vapor press. in shell coils of evap.	13.2	14.8

DATA OF TESTS OF DOUBLE EFFECT.

Number of test	No. 3.	No. 4.
Duration	2 hrs.	2 hrs.
Feed water from	City Mains	East River
Average lb. of steam used per hour	894	871
Average lb. of dist. water per hour	1,321	1,310
Lb. of water evaporated per lb. of steam	1.48	1.50
Average lb. of feed water per hour	1,321	1.578
Average lb. of blow-off water per hour	0	268
Average lb. of condensing water per hour	19,712	20,480
Average temp. of drip from coils from 1st effect	195° F.	197° F.
Average temp. of distilled water	145° F.	141° F.
Average temp of feed water	64.8° F.	100.8° F.
Average temp. of blow-off water		201° F.
Average initial temp. of condensing water	69.6° F.	69 8° F.
Average final temp. of condensing water	100.4° F.	100.8° F.
Average temp. of atmosphere	87° F.	90° F.
Average steam press. entering coils of 1st effect	75	73.8
Average vapor press. in shell of 1st effect	28.8	27.8
Average vapor press. in shell of 2d effect	6.9	6.6

DATA OF TESTS OF TRIPLE EFFECT.

Number of test	No. 6.	No. 10.
Duration	6 hrs.	5 hrs.
Feed water from	City Mains	East River
Average lb. of steam used per hour	837	759
Average lb. of dist. water per hour	1,656	1,494
Lb. of water evaporated per lb. of steam	1.98	1.97
Average lb. of feed water per hour	1,656	1,982
Average lb. of blow-off water per hour		488
Average lb. of condensing water used per hour	19,392	19,456
Average temp. of drip from coils of 1st effect	195° F.	194° F.
Average temp. of dist. water	168° F.	172° F.
Average temp. of feed water	65° F.	91.4° F.
Average temp. of blow-off water		196° F.
Average initial temp. of condensing water	69 3° F.	70.5° F.
Average final temp. of condensing water	91.5°	91.4° F.
Average temp. of atmosphere	95° F.	89° F.
Average steam pres. entering coils of 1st effect	73	74.8
Average vapor press. in shell of 1st effect	33.4	35.5
Average vapor press. in shell of 2d effect	15.0	13.6
Average vapor press. in shell of 3d effect	4.0	3.6

Ostend Exhibition.—An exhibition of life saving devices and fisheries is to be held at Ostend, Belgium, during the months of August and September.

Capsized in Dry Dock.—The U. S. transport *Ingalls*, while being dry docked at the Erie Basin, Brooklyn, N. Y., on June 14, fell over upon her side owing to a misplaced bilge block and insufficient shoring. Most of the rigging and top hamper was carried away or severely damaged, and one workman was killed and twelve others severely inured.

FAULTS IN DYNAMOS.

BY LAMAR LYNDON.

(*Continued from page 308.*)

Excessive Heating:

Excessive heating endangers the machine and if not attended by an immediate burnout, if allowed to continue, will carbonize the insulation surrounding the heated part, and finally produce a complete or partial short circuit.

(1) Heating of connections. This may occur from excessive current strength, or bad contacts. When the contacts are not properly made with ample contact surface, or when grit, dirt, oil, insulation or any nonconducting substance creeps in and increases the resistance of the connections, the heat loss, depending on the resistance, will increase and the temperature will rise to a value greater than the normal.

Overloads sometimes cause the annoying occurrence known as "throwing solder." This is caused by heating at the points where the armature leads are soldered to the commutator bars. The excessive heat melts the solder and it is whirled off in a molten spray by the rotating armature. Unless the connectors are fairly stiff, they will fly loose from the commutator bars. This trouble is not so frequent now as dynamos are designed at present with large carrying capacity at the point of junction of connectors and commutator bars, so that their temperature will not rise above a moderate degree, except under extraordinary circumstances. In addition, the commutator bar lugs are rabbeted out, making a groove in which the connector ends are laid, and they are held in place by means of small set screws.

(2) Heating of commutator. This may occur from overloads, bad contact with the brushes, short circuit in commutator, heated bearings, or excessive pressure of brushes on commutator. Overloads show themselves in a number of ways and the engineer can usually discover them at once. Their chief effects are, as has been stated, heating the machine and causing sparking at the brushes. Bad contact with the brushes is usually discoverable by inspection. Short circuits in the commutator will act as a short circuit in the armature and cause overheating of all the coils included between the points short circuited. When the commutator and the bearings are both excessively hot, it is difficult to tell which has heated the other above its normal temperature. Heat is easily conducted between the commutator and the journal near it, and any excessive heat in one will cause a rise of temperature in the other. If the dynamos be run without load and the journal heats, this shows that the commutator may be heated by the journal when working on load. The present design of only two, self aligning, self oiling bearings, reduces the liability of any such difficulty, and in fact almost eliminates it. Direct driven machines, being carefully aligned, and usually running with cool bearings are also seldom subject to this fault. Excessive brush pressure will produce heat due to friction between the commutator and brushes. There is a little trouble from this source with the brush holders now made, but in certain old types the springs which press the brushes on to the commutator, acted also as current carriers, and were very liable to heat. The heat draws the temper and the springs loose their elasticity. The adjusting screws are then brought down tightly, pressing the brushes with an unyielding force against the commutator. The result is excessive commutator heating. All brush holders so designed as to use the spring to convey current, should be replaced by modern brush holders which have the spring insulated so that it cannot carry any current whatever, and is not subjected in any way to the action of heat.

(3) Heating of armature. This trouble may arise from overloads, short circuits in armature or commutator, or eddy currents in armature core or conductors. Short circuits and overloads have been discussed. Generally the only remedy for burnt out or injured coils in an armature is to remove the faulty coil and substitute a new one. Instances, however, have come under the writer's observation where melted shellac poured over an armature which has been previously warmed, has penetrated to some point where a partial short circuit existed, and insulated the parts sufficiently to make the machine operate satisfactorily. This, however, is only a temporary makeshift. The real remedy is to replace the coil.

Eddy currents often cause heating, the effect taking place generally in the core of the armature. In modern machines the core is so built up of laminated iron, the layers being magnetically insulated from each other, and the conductors so divided, that the energy losses from this source are not sufficiently great to cause undue heating. The test for this defect is to excite the field magnets from some external source of current, and run the machine with the brushes lifted. If the armature becomes hot all over, eddy currents are the cause of the heat. If the fields, commutator and brushes are all right, and no short or open circuits exist in the armature, this test may be made with the dynamo exciting its own fields, but with the external circuit open; that is, the only current supplied by the armature is that necessary to excite the fields. The only remedy for this defect is a new and properly constructed armature.

(4) Brush too wide. Heating will occur from this cause for the reasons given under (9) in division "Sparking at Brushes."

(5) Heating of field magnets. This may arise from excessive exciting current, short circuits in field coils or eddy currents in pole pieces. Excessive exciting current may be the result of excessive voltage in the case of a shunt machine or excessive current in a compound machine. The voltage or current, as the case may be, should be reduced to bring the machine to its normal temperature. Sometimes coils intended to be connected in series are joined in parallel, and in this case they will heat excessively and generally burn out. The remedy is to connect up properly. If a short circuit exists in one field coil, there will be less drop through it than there would be if it were in proper condition. Its resistance will therefore be lowered, and if the field coils are connected in series, a greater than the normal E. M. F. will be present at the terminals of the other coils, causing an increased current flow and consequently excessive heating. This, however, is not the case where the field coils are connected in parallel. It is so seldom, however, that the connections are in parallel that it may be considered as generally true that a short

circuit in one field coil will cause overheating of the others.

Eddy currents in pole pieces are caused usually by the improper designing of the armature. Toothed core armatures are more liable to produce this form of heating than the smooth body type. A proper design of teeth and air gap and magnetic density in the core prevents this trouble. It is practically non-existent in modern machines unless it happens to arise from a fluctuating exciting current due to irregularity of machine voltage or defective contacts from the brushes to the field coil, due to jumping and variation of their resistance with the motion of the machine. This eddy current heating takes place on the pole faces. The exciting coils also get hotter near the pole tips, due to the conduction of heat from the tips to the coil. The test for fluctating exciting current is to insert a galvanometer or low reading ammeter in the circuit from the brushes to the field coils, and note whether the pointer remains stationary or vibrates. In the latter case the exciting current fluctuates and the heating from eddy currents probably proceeds from this cause. It is to be noted that the ammeter or galvanometer used must be so constructed that the moving parts are very light and possess but little inertia, otherwise rapid pulsations will not be recorded.

(6) Excessive heating of bearings, being generally a mechanical trouble with which the marine engineer is thoroughly familiar, will not require discussion here except to mention that they may at times become heated by conduction of heat from the armature or commutator, and also from being magnetically pulled with great force against one side of the journals. In multipolar field magnets the armature should be adjusted exactly in the center of the circle bounded by the pole pieces. In bipolar machines the armature should be set slightly off center, being moved *away* from the field coils. Thus in a machine with vertical magnets and the armature placed above the field coils, the armature should be moved slightly above its central position. Otherwise the pressure on the journals might be far greater than that due to the weight of the armature and heating would probably result. The amount of displacement from the center should be very small, generally about 1-6 to 1-8 the distance across the air gap. It will often be found that where bearings get worn and allow the armature to sink to a slightly lower position and approach nearer the poles on the lower side, receding from them on the upper, the magnetic attraction tending to draw the armature down becomes very great. The remedy is to re-line the journals or adjust them upwards (if they are constructed so that this may be done), until the armature is brought to its normal position.

Variation in Voltage:

This trouble may arise from (1) Irregularity of speed. This will be obvious, and the cause may generally be easily located.

(2) Bad joints in belt. These will cause a jump or flicker in the lamps as they pass over the dynamo pulley. The proper form of belt joint is none at all, i. e., the belt should be made endless.

(3) Short or open circuits in armature. Either of these will generally produce a pulsation of voltage that is periodic and pulsates with each revolution (if bipolar), or passage of bad coil from position under one north pole to the next north pole (if multipolar). The location of these faults and their remedy has been previously given.

(4) Short, or open circuits in field coils. If a short or open circuit be present in the field coils or any of their connections a diminution of voltage will result. Location of and remedy for this trouble have before been mentioned.

(5) Incorrect connections. In case of a newly erected machine, the voltage may be found greater or less than its normal. This is often attributable to the field coils being wrongly connected up. If the error is such as to produce excess of voltage, the coils will be abnormally hot. If the voltage is too low (and no short circuit exists) the coils will be very cool. The connections should all be traced out and properly changed.

Excessive Noise or Vibration:

The possible causes of this trouble are:

(1) Bad foundations. This has been mentioned and the remedy is obvious.

(2) Loose screws and connections. If there are any loose connections, bolts, etc., they will vibrate and rattle. In addition they cause electrical troubles before mentioned.

(3) Rough belt joints. This trouble is easily located and the remedy in all cases should be an endless belt.

(4) Excessive brush pressure. In addition to causing heating, excessive brush pressure generally produces a singing noise at the commutator, especially if the latter is a little rough. Smooth the commutator, slack up on the brushes and lubricate with a very small quantity of vaseline.

(5) Armature out of balance. This trouble is not frequent now unless the shaft be bent by some accident. If the armature be taken out and put on balancing ways, this trouble can be located. A bent shaft can nearly always be discovered by careful inspection. If the shaft is bent, the remedy is simply to straighten it, and take off a finishing cut in the lathe. Usually this cannot be done without removing the armature and commutator from the shaft. If the shaft is straight and the armature out of balance, small weights must be added to the light side. Often, additional solder on the binding wires will be sufficient. If the machine be belted, the drive pulley and armature should be balanced *separately*. The solder or weights added to the light side of the armature should be as nearly opposite the center of gravity of the excess weight on the heavy side as possible—that is, the counterbalance weight should be opposite to the excess weight, whether measured around the circumference of the armature or along its length.

(6) Armature rubbing against pole pieces. This fault is easily located by inspection and by the scraping noise produced when the armature rotates. It may be caused by a badly bent shaft, a loose winding, or journals wearing down. This fault is rare and not often met with, as machines are now usually designed with large air gaps and toothed armatures. Remedies for bent shafts and low journals have already been given. Loose windings, if they have run against the pole pieces more than a few revolutions, require to be replaced by a new coil. In case the injury has not been great

enough to require renewal, the loose portion should be driven back into position with a piece of wood or fiber, and secured either by binding wires or with the usual wedges used in toothed armatures.

Salving a Steamer.

During a severe storm on March 25 last the steamship *Dinnington* ran aground on the new breakwater at the entrance of harbor of Portland, England. Only the submerged part of the breakwater is finished and at high tide the rocks are covered with but two feet of water. The captain missed his bearing and was going at full speed when the steamer struck. She was

STEAMER DINNINGTON WRECKED ON PORTLAND BREAKWATER.

caught by the rocks amidships and at low tide was in the perilous position shown in the illustration. The after body was filled with water, and it was feared that the ship would slip off and sink to the bottom in 54 ft. of water.

Several attempts were made to pull her off by the combined power of four tugs. These proved futile and on examination it was found that some of the rocks had pierced the bottom and that with every wave the damage was increased. Work was given up and the ship was to be destroyed when a salvage company offered to recover it. Twice their men had to abandon the work owing to gales which destroyed all the preparations. The third attempt proved successful. A cofferdam was built around the after end of the ship and several powerful pumps removed the water from within. Thus the stern was raised and the tugs drew the ship off the rocks and into the harbor.

The work of salving was superintended by Capt. W. E. Anderson, the officer engaged by the United States to report upon the sinking of the battleship *Maine*.

The above facts and illustrations were obtained from the *Scientific American*.

Canadian Iron on the Clyde.—Pig iron from the furnaces at Cape Breton is being shipped to Scotland.

QUERIES AND ANSWERS.

Q.—Does an incandescent lamp give more light when it is new than after it has been in use several months? 2. Does the current it uses increase or decrease as it grows old? T. R. N.

A.—(1) The light given off by incandescent lamps gradually deteriorates, but in first-class lamps the change is very slow, and the difference in brilliancy between a new and an old lamp can hardly be detected by the naked eye.

(2) The strength of current required for incandescent lamps reduces gradually as they grow old, owing to the fact that the resistance gradually increases.

Q.—You would confer a favor by explaining in your "Queries and Answers" column the solution for obtaining the velocity of steam as per data on sketch inclosed. Also same for exhaust.

By giving the answer and solution you will greatly oblige, Subscriber.

A.—The term steam velocity is to some extent misleading. What is meant is not actual steam velocity at any given instant, but a quantity which is supposed to bear some relation to the average rate of flow throughout the stroke up to cut off. It may be found by the following proportion: As the area of the port opening is to the piston area, so is the mean piston speed to the steam velocity. Or again, we may express this by a rule as follows: Multiply the piston area by the piston speed, and divide by the area of port opening. The quotient will be the steam velocity. In the present case we have the following values.

Piston area	881 4
Piston speed = 2 × 4 × 120	960
Area of port opening for steam, top	123.4
Area of port opening for steam, bottom	149.3
Area of port opening for exhaust	183.75

The areas of port opening are found by multiplying the widths as given, by the circumference after deducting the bridging which is found to be 8 3-4 in. We thus have for the circumference 61 1-4 — 8 3-4 = 52 1-2, and this multiplied by the various widths will give the areas as above. Then for the steam velocity in top of cylinder we have the proportion 123.4 : 881.4 :: 960 : x. Solving we find 6,858 for the fourth term and hence the velocity desired. Or in other form : $v = 881.4 \times 960 \div 125.4 = 6,858$. In the same way we find for the steam velocity in the bottom of the cylinder the value 5,668, and for the exhaust velocity the value 4,605.

Q.—I have a small boat on which I want to attach a keel condenser which will maintain a satisfactory

vacuum, say, 24 in. for an 8 in. and 16 in. by 10 in. compound engine. Working boiler pressure, 175 lb.; cut off in H. P. cyl., 6 in. to 7 in.; rev. per min., 200-240; independent 4 in. by 6 in. by 5 in. Dean air pump; suction on pump, 2 in.; exhaust on l. p., 4 in. I want to lead outboard with a 4 in. or 4 1-2 in. pipe (preferably the latter size) and ultimately reduce to 2 in. the pump suction. I prefer to use the large size pipe as much as possible, to avoid stretching pipe along the keel any greater distance than is necessary to obtain a satisfactory vacuum. How many lineal feet of 4 in. or 4 1-2 in. pipe would you recommend with a proper reduction near the pump suction?

A.—The disadvantages of the keel condenser is always the small amount of surface which can be provided, and the moderate vacuum which can be maintained. You can hardly expect to maintain as good a vacuum as 24 in. with a keel condenser except under the most exceptionally good conditions. Furthermore there is comparatively small advantage in a large pipe over a small one, so far as adding condensing surface is concerned. A 4 in. pipe it is true has more surface per lineal foot than a 3 in. pipe, but on the other hand it is at a greater average distance from the steam within than for the smaller pipe. In other words a square foot of surface on a 3 in. pipe is worth more than on a 4 in. pipe, and it will be worth more yet on a 2 or 1 in. pipe. This is why in an internal condenser the tubes are made so small—usually 5-8 or 3-4 in. diameter. In your case it would undoubtedly be preferable to use a moderate size of pipe and considerable length rather than a large size and small length. You would probably do well to lead out with your exhaust 4 or 4 1-2 in. for a short distance, and then reduce to 3 in. and then to 2, carrying the pipe as far aft as you conveniently can. The addition of a few feet of pipe will probably be worth more in vacuum than the loss occasioned by the added resistance to the boat.

TECHNICAL PUBLICATIONS.

Modern Seamanship. By Lieutenant-Commander A. M. Knight, U. S. N. Pages 416 with 136 full-page plates and copious index. Size, 6 in. by 9 1-4 in. New York, D. Van Nostrand & Co.

In this work the purpose is to cover a somewhat wider field than is covered by most of the existing works on the same subject. Fuller recognition than hitherto has obtained is made of the fact that the modern typical ship is not a sailing ship but a steamer. While, indeed, this point of view has been recognized in certain works on the same subject prepared more especially for the use of the Merchant Marine, such has not been the case to the same extent with the existing works written from the naval standpoint.

In the present work, which is written from the naval standpoint and especially for the use of cadets and officers of the United States Navy, the purpose has been to place the main emphasis on the steamer and her management rather than on the older sailing ship, typical as she was of the service fifty years ago.

It must not be supposed, however, that the sailing ship or her rigging, sails or manœuvring are slighted in the present work. They are treated with sufficient fulness for all purposes connected with the needs of naval officers, and probably with far greater fulness than will ever be required in the service of the future. It is hard, however, to break away from the traditions of the past and the author has done well to reduce to as small limits as he has the matter relating to sailing ships alone.

In the matter relating more especially to steamers particular mention may be made of the chapters on the steering of steamers, on the rules of the road, on manœuvring to avoid a collision, on handling steamers in heavy weather, and on towing. Lack of space forbids a detailed reference to the many notable features of the work.

The author's style throughout is simple and clear and the full index provided will facilitate reference to any subject on which information may be desired. In this connection it may be noted that after page 370 the page numbers in the index are less by one than they should be.

Especial reference should be made to the illustrations by which the text is accompanied. There are 136 full-page inset plates, many of them containing several figures, most of which have been specially prepared for this work. As a rule they are most excellent in selection and execution, and form a most valuable feature of the work. Among such excellent illustrations it may not be out of place, however, to refer to the object being lifted in Fig. 49. It is presumably intended to represent a boiler, but if so, of a type found neither in heaven nor earth.

Taken as a whole this work is one of notable importance and it will most certainly take its place by right as an authority on the subject with which it deals. It may be recommended with confidence to all those interested in the general subject of seamanship, especially from the naval standpoint.

A B C of the Telephone. By J. E. Homans. Pages 332, with index. Size, 5 in. by 7 1-2 in. Theo. Audel & Co., New York.

This book is intended as an elementary and descriptive treatment of the modern telephone industry, with the leading features of its development to the present time. It does not deal with questions of advanced theory, but rather with the practical description and operation of the various appliances which the telephone industry has brought into use. It is intended for the non-professional reader or as an introduction for the student to the general field covered by the telephone industry.

The book is clearly written in simple language, and a short glossary of the more important technical words is added at the back. Illustrations are freely introduced and the whole subject is presented in a manner which should commend the book to those for whom it has been especially prepared. The book should prove of much interest and value to those who may wish to obtain a general acquaintance with telephone apparatus and methods, and it may be recommended to all such as well suited to their purpose.

Repairs to Shamrock II.—The cost of refitting sails and spars on *Shamrock II* amounted to about $25,000, and has been paid by London underwriters.

Collision.—The Joy line steamer *Tremont* collided with the steam yacht *Wild Duck* in Long Island Sound during a fog on the night of July 16. The *Tremont* was badly damaged, but remained afloat until she was towed into New London harbor, where she sank in shallow water. All the passengers were saved by other Sound boats which came to her assistance. The bow of the *Wild Duck* was crushed in, but she went to port under her own steam.

SELECTED MARINE PATENTS.

675,929. MARINE PROPELLER. JEREMIAH D. BROWN, PLAINFIELD, N. J.

CLAIMS.—An improved marine propeller comprising an endless chain with paddles mounted upon same, driven by sprocket wheels.

675,935. STAY BOLT FOR STEAM BOILERS. JOHN H. DAVENPORT, OMAHA, NEB.

675,969. DEVICE FOR PREVENTING RACING OF MARINE ENGINES. JOHN T. PARRY, JACKSONVILLE, FLA.

CLAIMS.—An apparatus comprising a tube extending longitudinally the length of the vessel, said tube to be filled with a liquid, opening into a cylinder with a piston connected to a throttle valve. When the stern of the vessel rises the liquid in the tube flows into the cylinder, raises the piston and thereby shuts off steam from the main engine.

676,075. MEANS AND MECHANISM FOR UNLOADING ORE, COAL, ETC., FROM VESSELS TO DOCKS, CARS. ALEX. M'DOUGALL DULUTH, MINN.

676,112. STEAM-GENERATOR. WILLIAM B. BARKER, LIVERPOOL, ENGLAND.

CLAIMS.—In a steam generator a pipe leading from below the lowest furnace within the generator, to a point above the water line, then outside the generator, returning by a loop to a point within, above the water line.

676,113. STEAM BOILER. JOHN B. BENDER, TOLEDO, OHIO.

CLAIMS. A water tube boiler provided with front and back water legs, with water tubes connecting and passing through the water legs.

676,143. APPLIANCE FOR TRANSPORTATION OF COAL OR OTHER SUPPLIES, CHIEFLY DESIGNED FOR SHIPS AT SEA. G. C. MACKROW AND H. C. CAMERON, LONDON, ENGLAND.

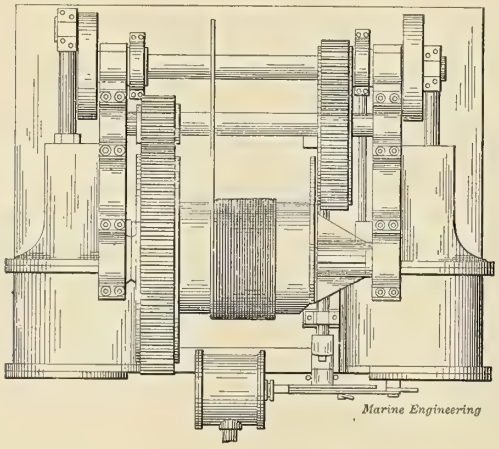
CLAIMS.—In a transporting apparatus, the combination with an endless cable for transporting and sustaining loads during their transit, means for supporting and taking up the slack of said rope, means for raising and lowering loads to and from conveying cable, and means for operating cables.

676,162. WATER TUBE STEAM BOILER. DAVID R. TODD, MANCHESTER, ENGLAND.

676,164. PROPULSION OF BOATS, YACHTS OR THE LIKE. G. VILLAR, CHILTENHAM, ENGLAND.

CLAIMS.—The combination of a combustion chamber, with oil supply pump and air inlet, of one or more passages from said chamber to the water, valves for opening or closing said passages, and means for intermittently exploding the charge.

676,196. TOWING MACHINE. F. METCALF, CLEVELAND, OHIO.



Marine Engineering

CLAIMS.—In a towing machine the combination, with a towing engaging drum, a fluid pressure engine, a connection between engine shaft and drum, means for conducting fluid under pressure to engine, and a valve to automatically control supply of fluid.

676,820. APPARATUS POR LOCATING SUNKEN VESSELS. SIMON LAKE, NEW YORK CITY.

676,889. MEANS FOR PREVENTING BREAKING OF PROPELLER SHAFTS. F. M. GASPARINI, VENICE, ITALY.

CLAIMS.—The combination with the propeller shaft, of a cooling chamber around said shaft, through which water circulates.

676,900. PROPELLER. ISADOR LEHMAN, CLEVELAND, OHIO.

676,926. APPARATUS FOR CLEANING HULLS OF VESSELS. MAJOR A. STUMP AND A. L. STUMP, NORMANTOWN, W. VA.

CLAIMS.—In combination with a scraper, means for grinding and operating same from the decks, over the side and bottom plating of the vessel,

676,986. METHOD OF BUILDING SHIPS. ALEXANDER LAMBIE, PORT GLASGOW, SCOTLAND.

CLAIMS.—Improvements in the structure of ships, comprising inside and outside strake plates, each with joggled or double bent lapjoint at one end, to overlap the end of next plate in line with it, and the shell landing of inside plates being joggled over lap joints of out side strakes.

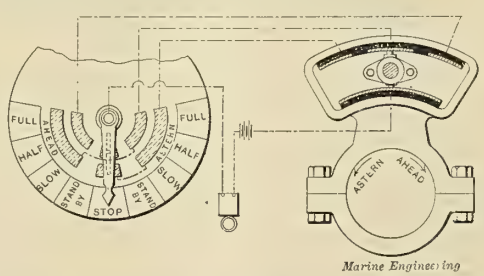
677,020. SHIP'S LOG. J. C. COOMBS AND A. N. M'GRAY, BOSTON, MASS.

CLAIMS.—In a ship's log, means for preventing water entering, and expelling water from, the interior of log casing.

677,024.—LUBRICATING APPARATUS. W. J. FAUL, NEW YORK, N. Y.

677,101. PROPELLER FOR VESSELS. H. V. B. PARKER, SAN FRANCISCO, CAL.

677,169. ALARM FOR ENGINE ROOM TELEGRAPHS AND THE LIKE. THOMAS BELL, LIVERPOOL, ENGLAND.



Marine Engineering

CLAIMS.—In engine telegraph alarms in combination; the dial; the series of pairs of dial contact pieces; the pointer arranged to electrically connect each pair of contact pieces; the weight shaft; second set of contact pieces on the weight shaft; a generator and alarm.

677,275. STEAM ENGINE INDICATOR. JAMES L. ROBERTSON, JR., NEW YORK, N. Y.

CLAIMS.—In a steam engine indicator, means for preventing the operator from burning his hand, comprising a spring covering for the piston cylinder; a take up device for tightening the drum cord.

FOREIGN SUBSIDIES.—The British Government has published reports from its consuls concerning the amount of shipping subsidies paid by other European nations.

COAL OUTPUT FOR 1900.—Official reports of the coal output of the United States for last year state that 267,540,000 short tons were mined, and valued at nearly $300,000,000. This is an increase in value of 15 per cent. over last year and an increase of 15,000,000 tons over the output of English mines.